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METHODS OF TREATING AND PREVENTING RSV, HMPV, AND PIV USING ANTI-RSV, ANTI-HMPV, AND ANTI-PIV ANTIBODIES

Abstract:

Abstract of WO2004010935

The present invention relates to methods for broad spectrum prevention and treatment of viral respiratory infections. In particular, the present invention relates to methods for preventing, treating or ameliorating symptoms associated with respiratory syncytial virus (RSV), parainfluenza virus (PIV), and/or human metapneumovirus (hMPV) infection, the methods comprising administering to a subject an effective amount of one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof, one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof, and/or one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof. In certain embodiments, a certain serum titer of the anti-RSV-antigen antibodies, anti-PIV-antigen antibodies, and/or anti-hMPV-antigen antibodies or antigen-binding fragments thereof is achieved in said subject. In certain specific embodiments, the subject is human and, preferably, the anti-RSV-antigen antibody, anti-PIV-antigen antibody, and/or anti-hMPV-antigen antibodies are human or humanized. The present invention relates further to compositions comprising the anti-RSV-antigen antibodies, anti-PIV-antigen antibodies, and/or anti-hMPV-antigen antibodies or antigen-binding fragments thereof. The present invention also relates to detectable or diagnostic compositions comprising the one or more anti-RSV-antigen antibodies, anti-PIV-antigen antibodies, and/or anti-hMPV-antigen antibodies or antigen binding fragments thereof and methods for detecting or diagnosing RSV, PIV, and/or hMPV infection utilizing the compositions.

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**METHODS OF TREATING AND
PREVENTING RSV,
HMPV, AND PIV USING ANTI-RSV, ANTI-
HMPV, AND ANTI-PIV ANTIBODIES**

RELATED APPLICATIONS

This application claims benefit of United States provisional application No.: 60/398,475, filed July 25, 2002, which is incorporated herein by reference in its entirety.

1. INTRODUCTION

The present invention provides methods for broad spectrum prevention and treatment of viral respiratory infection. In particular, the present invention relates to methods for preventing, treating or ameliorating symptoms associated with respiratory syncytial virus (RSV), parainfluenza virus (PIV), and/or human metapneumovirus (hMPV) infection, the methods comprising administering to a subject an effective amount of one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof, one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof, and/or one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof. In certain embodiments, a certain serum titer of the anti-RSV-antigen antibodies, anti-PIV-antigen antibodies, and/or anti-hMPV-antigen antibodies or antigen-binding fragments thereof is achieved in said subject. In certain specific embodiments, the subject is human and, preferably, the anti-RSV-antigen antibody, anti-PIV-antigen antibody, and/or anti-hMPV-antigen antibodies are human or humanized. The present invention relates further to compositions comprising the anti-RSV-antigen antibodies, anti-PIV-antigen antibodies, and/or anti-hMPV-antigen antibodies or antigen-binding fragments thereof. The present invention also relates to detectable or diagnostic compositions comprising the one or more anti-RSV-antigen antibodies, anti-PIV-antigen antibodies, and/or anti-hMPV-antigen antibodies or antigen-binding fragments thereof and methods for detecting or diagnosing RSV, PIV and/or hMPV infection utilizing the compositions.

2. BACKGROUND OF THE INVENTION

2.1. PIV INFECTIONS

Parainfluenza viral infection results in serious respiratory tract disease in infants and children. (Tao, *et al.*, 1999, Vaccine 17: 1100-08). Infectious parainfluenza viral infections account for approximately 20% of all hospitalizations of pediatric patients suffering from respiratory tract infections worldwide. *Id.*

PIV is a member of the paramyxovirus genus of the paramyxovirus family. PIV is made up of two structural modules: (1) an internal ribonucleoprotein core, or nucleocapsid, containing the viral genome, and (2) an outer, roughly spherical lipoprotein envelope. Its genome is a single strand of negative sense RNA, approximately 15,456 nucleotides in length, encoding at least eight polypeptides. These proteins include, but are not limited to, the nucleocapsid structural protein (NP, NC, or N depending on the genera), the phosphoprotein (P), the matrix protein (M), the fusion glycoprotein (F), the hemagglutinin-neuraminidase glycoprotein (HN), the large polymerase protein (L), and the C and D proteins of unknown function. *Id.*

The parainfluenza nucleocapsid protein (NP, NC, or N) consists of two domains within each protein unit including an amino-terminal domain, comprising about two-thirds of the molecule, which interacts directly with the RNA, and a carboxyl-terminal domain, which lies on the surface of the assembled nucleocapsid. A hinge is thought to exist at the junction of these two domains thereby imparting some flexibility to this protein (see Fields *et al.* (ed.), 1991, Fundamental Virology, Second Edition, Raven Press, New York, incorporated by reference herein in its entirety). The matrix protein (M), is apparently involved with viral assembly and interacts with both the viral membrane as well as the nucleocapsid proteins. The phosphoprotein (P), which is subject to phosphorylation, is thought to play a regulatory role in transcription, and may also be involved in methylation, phosphorylation and polyadenylation. The fusion glycoprotein (F) interacts with the viral membrane and is first produced as an inactive precursor, then cleaved post-translationally to produce two disulfide linked polypeptides. The active F protein is also involved in penetration of the parainfluenza virion into host cells by facilitating fusion of the viral envelope with the host cell plasma membrane. *Id.* The glycoprotein, hemagglutinin-neuraminidase (HN), protrudes from the envelope allowing the virus to contain both hemagglutinin and neuraminidase activities. HN is strongly hydrophobic at its amino terminal which functions to anchor the HN protein into

the lipid bilayer. *Id.* Finally, the large polymerase protein (L) plays an important role in both transcription and replication. *Id.*

2.2 RSV INFECTIONS

Respiratory syncytial virus (RSV) is the leading cause of serious lower respiratory tract disease in infants and children (Feigen et al., eds., 1987, *In: Textbook of Pediatric Infectious Diseases*, WB Saunders, Philadelphia at pages 1653-1675; New Vaccine Development, Establishing Priorities, Vol. 1, 1985, National Academy Press, Washington DC at pages 397-409; and Ruuskanen et al., 1993, *Curr. Probl. Pediatr.* 23:50-79). The yearly epidemic nature of RSV infection is evident worldwide, but the incidence and severity of RSV disease in a given season vary by region (Hall, C.B., 1993, *Contemp. Pediatr.* 10:92-110). In temperate regions of the northern hemisphere, it usually begins in late fall and ends in late spring. Primary RSV infection occurs most often in children from 6 weeks to 2 years of age and uncommonly in the first 4 weeks of life during nosocomial epidemics (Hall et al., 1979, *New Engl. J. Med.* 300:393-396). Children at increased risk from RSV infection include, but are not limited to, preterm infants (Hall et al., 1979, *New Engl. J. Med.* 300:393-396) and children with bronchopulmonary dysplasia (Groothuis et al., 1988, *Pediatrics* 82:199-203), congenital heart disease (MacDonald et al., *New Engl. J. Med.* 307:397-400), congenital or acquired immunodeficiency (Ogra et al., 1988, *Pediatr. Infect. Dis. J.* 7:246-249; and Pohl et al., 1992, *J. Infect. Dis.* 165:166-169), and cystic fibrosis (Abman et al., 1988, *J. Pediatr.* 113:826-830). The fatality rate in infants with heart or lung disease who are hospitalized with RSV infection is 3%-4% (Navas et al., 1992, *J. Pediatr.* 121:348-354).

RSV infects adults as well as infants and children. In healthy adults, RSV causes predominantly upper respiratory tract disease. It has recently become evident that some adults, especially the elderly, have symptomatic RSV infections more frequently than had been previously reported (Evans, A.S., eds., 1989, *Viral Infections of Humans. Epidemiology and Control*, 3rd ed., Plenum Medical Book, New York at pages 525-544). Several epidemics also have been reported among nursing home patients and institutionalized young adults (Falsey, A.R., 1991, *Infect. Control Hosp. Epidemiol.* 12:602-608; and Garvie et al., 1980, *Br. Med. J.* 281:1253-1254). Finally, RSV may cause serious disease in immunosuppressed persons, particularly bone marrow transplant patients (Hertz et al., 1989, *Medicine* 68:269-281).

Treatment options for established RSV disease are limited. Severe RSV disease of the lower respiratory tract often requires considerable supportive care, including administration of humidified oxygen and respiratory assistance (Fields et al., eds, 1990, *Fields Virology*, 2nd ed., Vol. 1, Raven Press, New York at pages 1045-1072).

While a vaccine might prevent RSV infection, no vaccine is yet licensed for this indication. A major obstacle to vaccine development is safety. A formalin-inactivated vaccine, though immunogenic, unexpectedly caused a higher and more severe incidence of lower respiratory tract disease due to RSV in immunized infants than in infants immunized with a similarly prepared trivalent parainfluenza vaccine (Kim et al., 1969, *Am. J. Epidemiol.* 89:422-434; and Kapikian et al., 1969, *Am. J. Epidemiol.* 89:405-421). Several candidate RSV vaccines have been abandoned and others are under development (Murphy et al., 1994, *Virus Res.* 32:13-36), but even if safety issues are resolved, vaccine efficacy must also be improved. A number of problems remain to be solved. Immunization would be required in the immediate neonatal period since the peak incidence of lower respiratory tract disease occurs at 2-5 months of age. The immaturity of the neonatal immune response together with high titers of maternally acquired RSV antibody may be expected to reduce vaccine immunogenicity in the neonatal period (Murphy et al., 1988, *J. Virol.* 62:3907-3910; and Murphy et al., 1991, *Vaccine* 9:185-189). Finally, primary RSV infection and disease do not protect well against subsequent RSV disease (Henderson et al., 1979, *New Engl. J. Med.* 300:530-534).

Currently, the only approved approach to prophylaxis of RSV disease is passive immunization. Initial evidence suggesting a protective role for IgG was obtained from observations involving maternal antibody in ferrets (Prince, G.A., Ph.D. diss., University of California, Los Angeles, 1975) and humans (Lambrecht et al, 1976, *J. Infect. Dis.* 134:211-217; and Glezen et al., 1981, *J. Pediatr.* 98:708-715). Hemming et al. (Morell et al., eds., 1986, *Clinical Use of Intravenous Immunoglobulins*, Academic Press, London at pages 285-294) recognized the possible utility of RSV antibody in treatment or prevention of RSV infection during studies involving the pharmacokinetics of an intravenous immune globulin (IVIG) in newborns suspected of having neonatal sepsis. They noted that 1 infant, whose respiratory secretions yielded RSV, recovered rapidly after IVIG infusion. Subsequent analysis of the IVIG lot revealed an unusually high titer of RSV neutralizing antibody. This same group of investigators then examined the ability of hyperimmune serum or immune globulin, enriched for RSV neutralizing antibody, to protect cotton rats and primates against

RSV infection (Prince et al., 1985, *Virus Res.* 3:193-206; Prince et al., 1990, *J. Virol.* 64:3091-3092; Hemming et al., 1985, *J. Infect. Dis.* 152:1083-1087; Prince et al., 1983, *Infect. Immun.* 42:81-87; and Prince et al., 1985, *J. Virol.* 55:517-520). Results of these studies suggested that RSV neutralizing antibody given prophylactically inhibited respiratory tract replication of RSV in cotton rats. When given therapeutically, RSV antibody reduced pulmonary viral replication both in cotton rats and in a nonhuman primate model. Furthermore, passive infusion of immune serum or immune globulin did not produce enhanced pulmonary pathology in cotton rats subsequently challenged with RSV.

Recent clinical studies have demonstrated the ability of this passively administered RSV hyperimmune globulin (RSV IVIG) to protect at-risk children from severe lower respiratory infection by RSV (Groothuis et al., 1993, *New Engl. J. Med.* 329:1524-1530; and The PREVENT Study Group, 1997, *Pediatrics* 99:93-99). While this is a major advance in preventing RSV infection, this treatment poses certain limitations in its widespread use. First, RSV IVIG must be infused intravenously over several hours to achieve an effective dose. Second, the concentrations of active material in hyperimmune globulins are insufficient to treat adults at risk or most children with compromised cardiopulmonary function. Third, intravenous infusion necessitates monthly hospital visits during the RSV season. Finally, it may prove difficult to select sufficient donors to produce a hyperimmune globulin for RSV to meet the demand for this product. Currently, only approximately 8% of normal donors have RSV neutralizing antibody titers high enough to qualify for the production of hyperimmune globulin.

One way to improve the specific activity of the immunoglobulin would be to develop one or more highly potent RSV neutralizing monoclonal antibodies (MAbs). Such MAbs should be human or humanized in order to retain favorable pharmacokinetics and to avoid generating a human anti-mouse antibody response, as repeat dosing would be required throughout the RSV season. Two glycoproteins, F and G, on the surface of RSV have been shown to be targets of neutralizing antibodies (Fields et al., 1990, *supra*; and Murphy et al., 1994, *supra*). These two proteins are also primarily responsible for viral recognition and entry into target cells; G protein binds to a specific cellular receptor and the F protein promotes fusion of the virus with the cell. The F protein is also expressed on the surface of infected cells and is responsible for subsequent fusion with other cells leading to syncytia formation. Thus, antibodies to the F protein may directly neutralize virus or block entry of the virus into the cell or prevent syncytia formation. Although antigenic and structural

differences between A and B subtypes have been described for both the G and F proteins, the more significant antigenic differences reside on the G glycoprotein, where amino acid sequences are only 53% homologous and antigenic relatedness is 5% (Walsh et al., 1987, J. Infect. Dis. 155:1198-1204; and Johnson et al., 1987, Proc. Natl. Acad. Sci. USA 84:5625-5629). Conversely, antibodies raised to the F protein show a high degree of cross-reactivity among subtype A and B viruses. Beeler and Coelingh (1989, J. Virol. 7:2941-2950) conducted an extensive analysis of 18 different murine MAbs directed to the RSV F protein. Comparison of the biologic and biochemical properties of these MAbs resulted in the identification of three distinct antigenic sites (designated A, B, and C). Neutralization studies were performed against a panel of RSV strains isolated from 1956 to 1985 that demonstrated that epitopes within antigenic sites A and C are highly conserved, while the epitopes of antigenic site B are variable.

A humanized antibody directed to an epitope in the A antigenic site of the F protein of RSV, SYNAGIS®, is approved for intramuscular administration to pediatric patients for prevention of serious lower respiratory tract disease caused by RSV at recommended monthly doses of 15 mg/kg of body weight throughout the RSV season (November through April in the northern hemisphere). SYNAGIS® is a composite of human (95%) and murine (5%) antibody sequences. See, Johnson et al., 1997, J. Infect. Diseases 176:1215-1224 and U.S. Patent No. 5,824,307, the entire contents of which are incorporated herein by reference. The human heavy chain sequence was derived from the constant domains of human IgG₁ and the variable framework regions of the VH genes of Cor (Press et al., 1970, Biochem. J. 117:641-660) and Cess (Takashi et al., 1984, Proc. Natl. Acad. Sci. USA 81:194-198). The human light chain sequence was derived from the constant domain of C κ and the variable framework regions of the VL gene K104 with J κ -4 (Bentley et al., 1980, Nature 288:5194-5198). The murine sequences derived from a murine monoclonal antibody, Mab 1129 (Beeler et al., 1989, J. Virology 63:2941-2950), in a process which involved the grafting of the murine complementarity determining regions into the human antibody frameworks.

2.3 AVIAN AND HUMAN METAPNEUMOVIRUS

Recently, a new member of the *Paramyxoviridae* family has been isolated from 28 children with clinical symptoms reminiscent of those caused by hRSV infection, ranging from mild upper respiratory tract disease to severe bronchiolitis and pneumonia (Van Den Hoogen et al., 2001, Nature Medicine 7:719-724). The new virus was named human

metapneumovirus (hMPV) based on sequence homology and gene constellation. The study further showed that by the age of five years virtually all children in the Netherlands have been exposed to hMPV and that the virus has been circulating in humans for at least half a century.

The genomic organization of human metapneumovirus is described in van den Hoogen et al, 2002, *Virology* 295:119-132. Human metapneumovirus has recently been isolated from patients in North America (Peret et al., 2002, *J. Infect. Diseases* 185:1660-1663).

Human metapneumovirus is related to avian metapneumovirus. For example, the F protein of hMPV is highly homologous to the F protein of APV. Alignment of the human metapneumoviral F protein with the F protein of an avian pneumovirus isolated from Mallard Duck shows 85.6% identity in the ectodomain. Alignment of the human metapneumoviral F protein with the F protein of an avian pneumovirus isolated from Turkey (subgroup B) shows 75% identity in the ectodomain. See, *e.g.*, co-owned and co-pending Provisional Application No.: 60/358,934, entitled "Recombinant Parainfluenza Virus Expression Systems and Vaccines Comprising Heterologous Antigens Derived from Metapneumovirus", filed on February 21, 2002, by Haller and Tang, which is incorporated herein by reference in its entirety.

Respiratory disease caused by an avian pneumovirus (APV) was first described in South Africa in the late 1970s (Buys et al., 1980, *Turkey* 28:36-46) where it had a devastating effect on the turkey industry. The disease in turkeys was characterized by sinusitis and rhinitis and was called turkey rhinotracheitis (TRT). The European isolates of APV have also been strongly implicated as factors in swollen head syndrome (SHS) in chickens (O'Brien, 1985, *Vet. Rec.* 117:619-620). Originally, the disease appeared in broiler chicken flocks infected with Newcastle disease virus (NDV) and was assumed to be a secondary problem associated with Newcastle disease (ND). Antibody against European APV was detected in affected chickens after the onset of SHS (Cook et al., 1988, *Avian Pathol.* 17:403-410), thus implicating APV as the cause.

The avian pneumovirus is a single stranded, non-segmented RNA virus that belongs to the sub-family *Pneumovirinae* of the family *Paramyxoviridae*, genus metapneumovirus (Cavanagh and Barrett, 1988, *Virus Res.* 11:241-256; Ling et al., 1992, *J. Gen. Virol.* 73:1709-1715; Yu et al., 1992, *J. Gen. Virol.* 73:1355-1363). The *Paramyxoviridae* family is divided into two sub-families: the *Paramyxovirinae* and *Pneumovirinae*. The subfamily

Paramyxovirinae includes, but is not limited to, the genera: Paramyxovirus, Rubulavirus, and Morbillivirus. Recently, the sub-family *Pneumovirinae* was divided into two genera based on gene order, *i.e.* *pneumovirus* and *metapneumovirus* (Naylor et al., 1998, J. Gen. Virol., 79:1393-1398; Pringle, 1998, Arch. Virol. 143:1449-1159). The *pneumovirus* genus includes, but is not limited to, human respiratory syncytial virus (HRSV), bovine respiratory syncytial virus (BRSV), ovine respiratory syncytial virus, and mouse pneumovirus. The *metapneumovirus* genus includes, but is not limited to, European avian pneumovirus (subgroups A and B), which is distinguished from HRSV, the type species for the genus *pneumovirus* (Naylor et al., 1998, J. Gen. Virol., 79:1393-1398; Pringle, 1998, Arch. Virol. 143:1449-1159). The US isolate of APV represents a third subgroup (subgroup C) within *metapneumovirus* genus because it has been found to be antigenically and genetically different from European isolates (Seal, 1998, Virus Res. 58:45-52; Senne et al., 1998, In: Proc. 47th WPDC, California, pp. 67-68).

Electron microscopic examination of negatively stained APV reveals pleomorphic, sometimes spherical, virions ranging from 80 to 200 nm in diameter with long filaments ranging from 1000 to 2000 nm in length (Collins and Gough, 1988, J. Gen. Virol. 69:909-916). The envelope is made of a membrane studded with spikes 13 to 15 nm in length. The nucleocapsid is helical, 14 nm in diameter and has 7 nm pitch. The nucleocapsid diameter is smaller than that of the genera Paramyxovirus and Morbillivirus, which usually have diameters of about 18 nm.

Avian pneumovirus infection is an emerging disease in the USA despite its presence elsewhere in the world in poultry for many years. In May 1996, a highly contagious respiratory disease of turkeys appeared in Colorado, and an APV was subsequently isolated at the National Veterinary Services Laboratory (NVSL) in Ames, Iowa (Senne et al., 1997, Proc. 134th Ann. Mtg., AVMA, pp. 190). Prior to this time, the United States and Canada were considered free of avian pneumovirus (Pearson et al., 1993, In: Newly Emerging and Re-emerging Avian Diseases: Applied Research and Practical Applications for Diagnosis and Control, pp. 78-83; Hecker and Myers, 1993, Vet. Rec. 132:172). Early in 1997, the presence of APV was detected serologically in turkeys in Minnesota. By the time the first confirmed diagnosis was made, APV infections had already spread to many farms. The disease is associated with clinical signs in the upper respiratory tract: foamy eyes, nasal discharge and swelling of the sinuses. It is exacerbated by secondary infections. Morbidity

in infected birds can be as high as 100%. The mortality can range from 1 to 90% and is highest in six to twelve week old poult.

Avian pneumovirus is transmitted by contact. Nasal discharge, movement of affected birds, contaminated water, contaminated equipment; contaminated feed trucks and load-out activities can contribute to the transmission of the virus. Recovered turkeys are thought to be carriers. Because the virus is shown to infect the epithelium of the oviduct of laying turkeys and because APV has been detected in young poult, egg transmission is considered a possibility.

Based upon the recent work with hMPV, hMPV likewise appears to be a significant factor in human, particularly, juvenile respiratory disease.

Thus, these three viruses, RSV, hMPV, and PIV, cause a significant portion of human respiratory disease. What is needed is a broad spectrum prophylaxis to reduce the incidence of viral respiratory disease.

Citation or discussion of a reference herein shall not be construed as an admission that such is prior art to the present invention.

2.4 VIRUS ENTRY INTO HOST CELL

It is emerging that some of the enveloped viruses, *e.g.*, retrovirus, orthomyxovirus, filovirus, and paramyxovirus, might use a fusion mechanism involving so-called heptad repeats to gain entry into a host cell (Eckert et al., 2001, *Annu. Rev. Biochem.* 70:777-810; Weissenhorn et. al., 1999, *Mol. Membr. Biol.* 16:3-9; Lamb et. al., 1999, *Mol. Membr. Biol.* 16:11-19; Skehel et al., 2000, *Annu. Rev. Biochem.* 69:531-569; Bentz, J., 2000, *Biophys J.* 78:886-900; Peisajovich et. al., 2002, *Trends Biochem. Sci.* 27:183-190). According to this model, the fusion peptide located at the N-terminus of the F protein (*e.g.*, of paramyxovirus) is exposed to insert itself into the cell membrane. Further, fusion proteins undergo conformational changes during fusion (Wang et al., 2003, *Biochem. Biophys. Res. Comm.* 302:469-475). The highly conserved heptad repeat (HR) regions have been implicated in facilitation of the fusion process (Wang et al., 2003, *Biochem. Biophys. Res. Comm.* 302:469-475). Therefore, the heptad repeats are an attractive target for the prevention of virus infection and/or propagation through the inhibition of fusion with a host cell.

3 SUMMARY OF THE INVENTION

The present invention provides methods for broad spectrum prevention and treatment of viral respiratory infections. Viruses are major causes of severe respiratory infections, particularly in infants, prematurely born infants, the elderly, immunocompromised patients, recipients of transplants, etc. Respiratory infections can be effectively prevented and/or treated using the combination therapies/prophylaxes provided by the present invention. The present invention provides broad spectrum combination therapy/prophylaxis comprising administering to a subject (i) one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof; (ii) one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof; and/or (iii) one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof. By providing to the subject a plurality of antibodies directed to antigens of a variety of viruses, the risk of respiratory viral infection is reduced in the subject. A particular advantage of administering antibodies of different immunospecificities is that different strains of viruses and viruses with naturally occurring modifications do not escape the immunity of the subject but are recognized by at least one of the plurality of antibodies.

In certain embodiments, the invention provides a method of preventing a viral infection in a subject, said method comprising administering to the subject: (i) a prophylactically effective amount of one or more first antibodies or antigen-binding fragments thereof, wherein said one or more first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen; and (ii) a prophylactically effective amount of one or more second antibodies or antigen-binding fragments thereof, wherein said one or more second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen. In certain embodiments, the one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof neutralize RSV. In certain embodiments, the one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof neutralize hMPV. In certain embodiments, the one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof block RSV infection of cells of the subject. In certain embodiments, the one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof block hMPV infection of cells of the subject.

In certain embodiments, the invention provides a method of treating one or more symptoms of a respiratory viral infection in a subject, said method comprising administering to the subject: (i) a therapeutically effective amount of one or more first antibodies or antigen-binding fragments thereof, wherein said one or more first antibodies or antigen-

binding fragments thereof bind immunospecifically to a RSV antigen; and (ii) a therapeutically effective amount of one or more second antibodies or antigen-binding fragments thereof, wherein said one or more second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen.

In certain embodiments, the invention provides a method of passive immunotherapy, said method comprising administering to a subject: (i) a first dose of one or more first antibodies or antigen-binding fragments thereof, wherein said one or more first antibodies or a fragments thereof bind immunospecifically to a RSV antigen; and (ii) a second dose of one or more second antibodies or antigen-binding fragments thereof, wherein said one or more second antibodies or a fragments thereof bind immunospecifically to a hMPV antigen, wherein the first dose reduces the incidence of RSV infection by at least 25% and wherein the second dose reduces the incidence of hMPV infection by at least 25%. In certain embodiments, the first dose reduces the incidence of RSV infection by at least 50% and wherein the second dose reduces the incidence of hMPV infection by at least 50%. In certain embodiments, the first dose reduces the incidence of RSV infection by at least 75% and wherein the second dose reduces the incidence of hMPV infection by at least 75%. In certain embodiments, the first dose reduces the incidence of RSV infection by at least 90% and wherein the second dose reduces the incidence of hMPV infection by at least 90%.

In certain embodiments, the invention provides a method of passive immunotherapy, said method comprising administering to a subject: (i) a first dose of one or more first antibodies or antigen-binding fragments thereof, wherein said one or more first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen; and (ii) a second dose of one or more second antibodies or antigen-binding fragments thereof, wherein said one or more second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen, wherein the serum titer of said one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering said one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof and wherein the serum titer of said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof.

In certain embodiments, the amino acid sequence of the RSV antigen is that of SEQ ID NO:390 to 398, respectively. In certain embodiments, the amino acid sequence of the

RSV antigen is 90% identical to the amino acid sequence of RSV nucleoprotein, RSV phosphoprotein, RSV matrix protein, RSV small hydrophobic protein, RSV RNA-dependent RNA polymerase, RSV F protein, or RSV G protein. In certain embodiments, the RSV antigen is selected from the group consisting of RSV nucleoprotein, RSV phosphoprotein, RSV matrix protein, RSV small hydrophobic protein, RSV RNA-dependent RNA polymerase, RSV F protein, and RSV G protein. In certain embodiments, the one or more anti-RSV-antigen antibodies immunospecifically bind to an antigen of Group A or Group B RSV. In certain embodiments, the RSV antigen is RSV F protein. In certain embodiments, the one or more anti-hMPV-antigen antibodies cross-react with a turkey APV antigen. In certain embodiments, the one or more anti-hMPV-antigen antibodies are (i) human or humanized antibodies and (ii) cross-react with a turkey APV antigen. In certain embodiments, the turkey APV antigen is selected from the group consisting of turkey APV nucleoprotein, turkey APV phosphoprotein, turkey APV matrix protein, turkey APV small hydrophobic protein, turkey APV RNA-dependent RNA polymerase, turkey APV F protein, and turkey APV G protein. In certain embodiments, the turkey APV antigen is an antigen of avian pneumovirus type A, avian pneumovirus type B, or avian pneumovirus type C. In certain embodiments, the amino acid sequence of said turkey APV antigen is that of SEQ ID NO:424 to 429, respectively. In certain embodiments, the amino acid sequence of the hMPV antigen is that of SEQ ID NO:399 to 406, 420, or 421, respectively. In certain embodiments, the hMPV antigen is selected from the group consisting of hMPV nucleoprotein, hMPV phosphoprotein, hMPV matrix protein, hMPV small hydrophobic protein, hMPV RNA-dependent RNA polymerase, hMPV F protein, and hMPV G protein. In certain embodiments, the hMPV antigen is hMPV F protein. In certain embodiments, the anti-RSV-antigen antibody is SYNAGIS™ (Palivizumab); AFFF; P12f2 P12f4; P11d4; Ale9; A12a6; A13c4; A17d4; A4B4; 1X-493L1; FR H3-3F4; M3H9; Y10H6; DG; AFFF(1); 6H8; L1-7E5; L2-15B10; A13a11; A1h5; A4B4(1); A4B4-F52S; or A4B4L1FR-S28R. In certain embodiments, the effective amount of said one or more anti-RSV-antigen antibodies is 100 mg/kg or less. In certain embodiments, the effective amount of said one or more anti-RSV-antigen antibodies is 10 mg/kg or less. In certain embodiments, the effective amount of said one or more anti-RSV-antigen antibodies is 1 mg/kg or less. In certain embodiments, the effective amount of said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof is 100 mg/kg or less. In certain embodiments, the effective amount of said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof is 10 mg/kg

or less. In certain embodiments, the effective amount of said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof is 1 mg/kg or less. In certain embodiments, the one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof are administered at a time period prior to administering of said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof. In certain embodiments, the one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered at a time period prior to administering of said one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof. In certain embodiments, the one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof and said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered concurrently. In certain embodiments, the one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof are administered in a sequence of two or more administrations, wherein the administrations of said one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof are separated by a time period from each other, and wherein said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered before, during, or after the sequence. In certain embodiments, the one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof are administered in a sequence of two or more administrations, wherein the administrations of said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof are separated by a time period from each other, and wherein said one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof are administered before, during, or after the sequence. In certain embodiments, the one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof and said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered in a sequence of two or more administrations, wherein the administrations are separated by a time period from each other. In certain embodiments, the time period is at least 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, 1 week, 2 weeks, 3 weeks, 1 month, 2 months, or 3 months. In certain embodiments, the one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof and/or said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered by a nebulizer or an inhaler. In certain embodiments, the one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof and/or said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered intramuscularly, intravenously or subcutaneously. In certain embodiments, the viral infection is an infection with RSV and hMPV. In certain

embodiments, the viral infection is an infection with RSV and APV. In certain embodiments, at least one of said antibodies is a monoclonal antibody, a synthetic antibody, an intrabody, a chimeric antibody, a human antibody, a humanized chimeric antibody, a humanized antibody, a glycosylated antibody, a multispecific antibody, a human antibody, a single-chain antibody, or a bispecific antibody. In certain embodiments, at least one of said antibodies is a human antibody. In certain embodiments, at least one of said antibodies is a humanized antibody. In certain embodiments, at least one of said antibodies is a synthetic antibody. In certain embodiments, the subject is a mammal. In certain embodiments, the mammal is a primate. In certain embodiments, the primate is a human. In certain embodiments, the human is an elderly human. In certain embodiments, the human is a transplant recipient. In certain embodiments, the human is an immunocompromised patient. In certain embodiments, the human is an AIDS patient. In certain embodiments, the human is an infant. In certain embodiments, the human has cystic fibrosis, bronchopulmonary dysplasia, congenital heart disease, congenital immunodeficiency, or acquired immunodeficiency or has had a bone marrow transplant. In certain embodiments, infant was born prematurely or is at risk of hospitalization for a RSV infection and/or for a hMPV infection. In certain embodiments, the human infant was born prematurely. In certain embodiments, the infant is less than 32 weeks of gestational age. In certain embodiments, the infant is between 32 and 35 weeks of gestational age. In certain embodiments, the infant is more than 35 weeks of gestational age. In certain embodiments, the infant is more than 38 weeks of gestational age. In certain embodiments, the mammal is not a primate. In certain embodiments, the non-primate mammal is an animal model for RSV infection and/or hMPV infection. In certain embodiments, the non-primate mammal is a cotton rat. In certain embodiments, the antibody is administered once a month just prior to and during the RSV season. In certain embodiments, the antibody is administered every two months just prior to and during the RSV season. In certain embodiments, the antibody is administered once just prior to or during the RSV season. In certain embodiments, at least one of said fragments is a Fab fragment, a F(ab') fragment, a F(ab')₂ fragment, a Fd, a single-chain Fv, a disulfide-linked Fv, a fragment comprising a V_L domain, or a fragment comprising a V_H domain.

In certain embodiments, the invention provides a method of preventing a viral infection in a subject, said method comprising administering to the subject: (i) a dose of one or more antibodies or antigen-binding fragments thereof, wherein said one or more antibodies

or antigen-binding fragments thereof (i) are human or humanized, (ii) cross-react with a turkey APV antigen, and (iii) bind immunospecifically to a hMPV antigen.

In certain embodiments, the invention provides method of treating one or more symptoms of a respiratory viral infection in a subject, said method comprising administering to the subject: (i) a dose of one or more antibodies or antigen-binding fragments thereof, wherein said one or more antibodies or antigen-binding fragments thereof (i) are human or humanized, (ii) cross-react with a turkey APV antigen, and (iii) bind immunospecifically to a hMPV antigen.

In certain embodiments, the invention provides a method of passive immunotherapy, said method comprising administering to a subject: (i) a dose of one or more antibodies or antigen-binding fragments thereof, wherein said one or more antibodies or antigen-binding fragments thereof (i) are human or humanized, (ii) cross-react with a turkey APV antigen, and (iii) bind immunospecifically to a hMPV antigen, wherein the dose reduces the incidence of hMPV infection by at least 25%. In certain embodiments, wherein the dose reduces the incidence of hMPV infection by at least 50%. In certain embodiments, wherein the dose reduces the incidence of hMPV infection by at least 75%. In certain embodiments, wherein the dose reduces the incidence of hMPV infection by at least 90%.

In certain embodiments, the invention provides a method of passive immunotherapy, said method comprising administering to a subject: (i) a dose of one or more antibodies or antigen-binding fragments thereof, wherein said one or more antibodies or antigen-binding fragments thereof (i) are human or humanized, (ii) cross-react with a turkey APV antigen, and (iii) bind immunospecifically to a hMPV antigen, wherein the serum titer of said one or more antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering said one or more antibodies or antigen-binding fragments thereof.

In certain embodiments, the invention provides a pharmaceutical composition, said composition comprising: (i) one or more first antibodies or antigen-binding fragments thereof, wherein said one or more first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen; and (ii) one or more second antibodies or antigen-binding fragments thereof, wherein said one or more second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen. In certain embodiments, the amino acid sequence of the RSV antigen is that of SEQ ID NO:390 to 398, respectively. In certain embodiments, the amino acid sequence of the RSV antigen is 90% identical to the amino acid sequence of RSV nucleoprotein, RSV phosphoprotein, RSV matrix protein, RSV

small hydrophobic protein, RSV RNA-dependent RNA polymerase, RSV F protein, or RSV G protein. In certain embodiments, the RSV antigen is selected from the group consisting of RSV nucleoprotein, RSV phosphoprotein, RSV matrix protein, RSV small hydrophobic protein, RSV RNA-dependent RNA polymerase, RSV F protein, and RSV G protein. In certain embodiments, said one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof immunospecifically bind to an antigen of Group A or Group B RSV. In certain embodiments, the RSV antigen is RSV F protein. In certain embodiments, said one or more anti-hMPV-antigen antibodies cross-react with a turkey APV antigen. In certain embodiments, said one or more anti-hMPV-antigen antibodies are (i) human or humanized antibodies and (ii) cross-react with a turkey APV antigen. In certain embodiments, said turkey APV antigen is selected from the group consisting of turkey APV nucleoprotein, turkey APV phosphoprotein, turkey APV matrix protein, turkey APV small hydrophobic protein, turkey APV RNA-dependent RNA polymerase, turkey APV F protein, and turkey APV G protein. In certain embodiments, said turkey APV antigen is an antigen of avian pneumovirus type A, avian pneumovirus type B, or avian pneumovirus type C. In certain embodiments, the amino acid sequence of said turkey APV antigen is that of SEQ ID NO:424 to 429, respectively. In certain embodiments, the amino acid sequence of the hMPV antigen is that of SEQ ID NO:399 to 406, 420, or 421, respectively. In certain embodiments, the hMPV antigen is selected from the group consisting of hMPV nucleoprotein, hMPV phosphoprotein, hMPV matrix protein, hMPV small hydrophobic protein, hMPV RNA-dependent RNA polymerase, hMPV F protein, and hMPV G protein. In certain embodiments, the hMPV antigen is hMPV F protein. In certain embodiments, the anti-RSV-antigen antibody is SYNAGIS™; AFFF; P12f2 P12f4; P11d4; A1e9; A12a6; A13c4; A17d4; A4B4; 1X-493L1; FR H3-3F4; M3H9; Y10H6; DG; AFFF(1); 6H8; L1-7E5; L2-15B10; A13a11; A1h5; A4B4(1); A4B4-F52S; or A4B4L1FR-S28R. In certain embodiments, at least one of said antibodies is a monoclonal antibody, a synthetic antibody, an intrabody, a chimeric antibody, a human antibody, a humanized chimeric antibody, a humanized antibody, a glycosylated antibody, a multispecific antibody, a human antibody, a single-chain antibody, or a bispecific antibody. In certain embodiments, at least one of said antibodies is a human antibody. In certain embodiments, at least one of said antibodies is a humanized antibody. In certain embodiments, at least one of said antibodies is a synthetic antibody. In certain embodiments, at least one of said fragments is a Fab fragment, a F(ab') fragment, a F(ab')₂

fragment, a Fd, a single-chain Fv, a disulfide-linked Fv, a fragment comprising a V_L domain, or a fragment comprising a V_H domain.

In certain embodiments, the application provides a pharmaceutical composition, said composition comprising: one or more antibodies or antigen-binding fragments thereof, wherein said one or more antibodies or antigen-binding fragments thereof (i) are human or humanized, (ii) cross-react with a turkey APV antigen, and (iii) bind immunospecifically to a hMPV antigen.

In certain embodiments, the invention provides a method comprising administering to the subject: (i) a prophylactically effective amount of one or more first antibodies or antigen-binding fragments thereof, wherein said one or more first antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen; and (ii) a prophylactically effective amount of one or more second antibodies or antigen-binding fragments thereof, wherein said one or more second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen. In certain embodiments, said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof neutralize PIV. In certain embodiments, said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof neutralize hMPV. In certain embodiments, said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof block PIV infection of cells of the subject. In certain embodiments, said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof block hMPV infection of cells of the subject.

In certain embodiments, the invention provides a method of treating one or more symptoms of a respiratory viral infection in a subject, said method comprising administering to the subject: (i) a therapeutically effective amount of one or more first antibodies or antigen-binding fragments thereof, wherein said one or more first antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen; and (ii) a therapeutically effective amount of one or more second antibodies or antigen-binding fragments thereof, wherein said one or more second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen.

In certain embodiments, the invention provides a method of passive immunotherapy, said method comprising administering to a subject: (i) a first dose of one or more first antibodies or antigen-binding fragments thereof, wherein said one or more first antibodies or a fragments thereof bind immunospecifically to a PIV antigen; and (ii) a second dose of one or more second antibodies or antigen-binding fragments thereof, wherein said one or more

second antibodies or a fragments thereof bind immunospecifically to a hMPV antigen, wherein the first dose reduces the incidence of PIV infection by at least 25% and wherein the second dose reduces the incidence of hMPV infection by at least 25%. In certain embodiments, the first dose reduces the incidence of PIV infection by at least 50% and wherein the second dose reduces the incidence of hMPV infection by at least 50%. In certain embodiments, the first dose reduces the incidence of PIV infection by at least 75% and wherein the second dose reduces the incidence of hMPV infection by at least 75%. In certain embodiments, the first dose reduces the incidence of PIV infection by at least 90% and wherein the second dose reduces the incidence of hMPV infection by at least 90%.

In certain embodiments, the invention provides a method of passive immunotherapy, said method comprising administering to a subject: (i) a first dose of one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof, wherein said one or more first antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen; and (ii) a second dose of one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof, wherein said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen, wherein the serum titer of said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof and wherein the serum titer of said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof. In certain embodiments, the amino acid sequence of the PIV antigen is that of SEQ ID NO:407 to 419, respectively. In certain embodiments, the amino acid sequence of the PIV antigen is 90% identical to the amino acid sequence of PIV nucleocapsid phosphoprotein, PIV L protein, PIV matrix protein, PIV HN glycoprotein, PIV RNA-dependent RNA polymerase, PIV Y1 protein, PIV D protein, or PIV C protein. In certain embodiments, the PIV antigen is selected from the group consisting of PIV nucleocapsid phosphoprotein, PIV L protein, PIV matrix protein, PIV HN glycoprotein, PIV RNA-dependent RNA polymerase, PIV Y1 protein, PIV D protein, or PIV C protein. In certain embodiments, said one or more anti-hMPV-antigen antibodies immunospecifically bind to an antigen of human PIV type 1, human PIV type 2, human PIV type 3, or human PIV type 4. In certain embodiments, the PIV antigen is PIV F protein. In certain embodiments, said one or more anti-hMPV-antigen antibodies cross-react with a turkey APV

antigen. In certain embodiments, said one or more anti-hMPV-antigen antibodies are (i) human or humanized antibodies and (ii) cross-react with a turkey APV antigen. In certain embodiments, said turkey APV antigen is selected from the group consisting of turkey APV nucleoprotein, turkey APV phosphoprotein, turkey APV matrix protein, turkey APV small hydrophobic protein, turkey APV RNA-dependent RNA polymerase, turkey APV F protein, and turkey APV G protein. In certain embodiments, said turkey APV antigen is an antigen of avian pneumovirus type A, avian pneumovirus type B, or avian pneumovirus type C. In certain embodiments, the amino acid sequence of said turkey APV antigen is that of SEQ ID NO:424 to 429, respectively. In certain embodiments, the amino acid sequence of the hMPV antigen is that of SEQ ID NO:399-406, 420, or 421, respectively. In certain embodiments, the hMPV antigen is selected from the group consisting of hMPV nucleoprotein, hMPV phosphoprotein, hMPV matrix protein, hMPV small hydrophobic protein, hMPV RNA-dependent RNA polymerase, hMPV F protein, and hMPV G protein. In certain embodiments, the hMPV antigen is hMPV F protein. In certain embodiments, the effective amount of said one or more anti-PIV-antigen antibodies is 100 mg/kg or less. In certain embodiments, the effective amount of said one or more anti-PIV-antigen antibodies is 10 mg/kg or less. In certain embodiments, the effective amount of said one or more anti-PIV-antigen antibodies is 1 mg/kg or less. In certain embodiments, the effective amount of said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof is 100 mg/kg or less. In certain embodiments, the effective amount of said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof is 10 mg/kg or less. In certain embodiments, the effective amount of said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof is 1 mg/kg or less. In certain embodiments, said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof are administered at a time period prior to administering of said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof. In certain embodiments, said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered at a time period prior to administering of said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof. In certain embodiments, said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof and said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered concurrently. In certain embodiments, said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof are administered in a sequence of two or more administrations, wherein the administrations of

said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof are separated by a time period from each other, and wherein said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered before, during, or after the sequence. In certain embodiments, said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof are administered in a sequence of two or more administrations, wherein the administrations of said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof are separated by a time period from each other, and wherein said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof are administered before, during, or after the sequence. In certain embodiments, said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof and said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered in a sequence of two or more administrations, wherein the administrations are separated by a time period from each other. In certain embodiments, the time period is at least 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, 1 week, 2 weeks, 3 weeks, 1 month, 2 months, or 3 months. In certain embodiments, said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof and/or said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered by a nebulizer or an inhaler. In certain embodiments, said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof and/or said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered intramuscularly, intravenously or subcutaneously. In certain embodiments, the viral infection is an infection with PIV and hMPV. In certain embodiments, the viral infection is an infection with PIV and APV. In certain embodiments, at least one of said antibodies is a monoclonal antibody, a synthetic antibody, an intrabody, a chimeric antibody, a human antibody, a humanized chimeric antibody, a humanized antibody, a glycosylated antibody, a multispecific antibody, a human antibody, a single-chain antibody, or a bispecific antibody. In certain embodiments, at least one of said antibodies is a human antibody. In certain embodiments, at least one of said antibodies is a humanized antibody. In certain embodiments, at least one of said antibodies is a synthetic antibody. In certain embodiments, the subject is a mammal. In certain embodiments, the mammal is a primate. In certain embodiments, the primate is a human. In certain embodiments, the human is an elderly human. In certain embodiments, the human is a transplant recipient. In certain embodiments, the human is an immunocompromised patient. In certain embodiments, the human is an AIDS patient. In certain embodiments, the human is an infant. In certain embodiments, the

human has cystic fibrosis, bronchopulmonary dysplasia, congenital heart disease, congenital immunodeficiency, or acquired immunodeficiency or has had a bone marrow transplant. In certain embodiments, the infant was born prematurely or is at risk of hospitalization for a PIV infection and/or a hMPV infection. In certain embodiments, the infant was born prematurely. In certain embodiments, the infant is less than 32 weeks of gestational age. In certain embodiments, the infant is 32 and 35 weeks of gestational age. In certain embodiments, the infant is 35 weeks of gestational age. In certain embodiments, infant is more than 38 weeks of gestational age. In certain embodiments, the mammal is not a primate. In certain embodiments, the non-primate mammal is an animal model for PIV infection and/or hMPV infection. In certain embodiments, the non-primate mammal is a cotton rat. In certain embodiments, the antibody is administered once a month just prior to and during the PIV season. In certain embodiments, the antibody is administered every two months just prior to and during the PIV season. In certain embodiments, the antibody is administered once just prior to or during the PIV season. In certain embodiments, at least one of said fragments is a Fab fragment, a F(ab') fragment, a F(ab')₂ fragment, a Fd, a single-chain Fv, a disulfide-linked Fv, a fragment comprising a V_L domain, or a fragment comprising a V_H domain.

In certain embodiments, the invention provides a method of preventing a viral infection in a subject, said method comprising administering to the subject: (i) a prophylactically effective amount of one or more first antibodies or antigen-binding fragments thereof, wherein said one or more first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen; (ii) a prophylactically effective amount of one or more second antibodies or antigen-binding fragments thereof, wherein said one or more second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen; and (iii) a prophylactically effective amount of one or more third antibodies or antigen-binding fragments thereof, wherein said one or more third antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen. In certain embodiments, said one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof neutralize RSV. In certain embodiments, said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof neutralize hMPV. In certain embodiments, said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof neutralize PIV. In certain embodiments, said one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof block RSV infection of cells of the subject. In certain embodiments, said one or more anti-hMPV-antigen antibodies or antigen-binding fragments

thereof block hMPV infection of cells of the subject. In certain embodiments, said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof block PIV infection of cells of the subject.

In certain embodiments, the invention provides a method of treating one or more symptoms of a respiratory viral infection in a subject, said method comprising administering to the subject: (i) a therapeutically effective amount of one or more first antibodies or antigen-binding fragments thereof, wherein said one or more first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen; (ii) a therapeutically effective amount of one or more second antibodies or antigen-binding fragments thereof, wherein said one or more second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen; and (iii) a therapeutically effective amount of one or more third antibodies or antigen-binding fragments thereof, wherein said one or more third antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen.

In certain embodiments, the invention provides a method of passive immunotherapy, said method comprising administering to a subject: (i) a first dose of one or more first antibodies or antigen-binding fragments thereof, wherein said one or more first antibodies or a fragments thereof bind immunospecifically to a RSV antigen; (ii) a second dose of one or more second antibodies or antigen-binding fragments thereof, wherein said one or more second antibodies or a fragments thereof bind immunospecifically to a hMPV antigen; and (iii) a third dose of one or more third antibodies or antigen-binding fragments thereof, wherein said one or more third antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen, wherein the first dose reduces the incidence of RSV infection by at least 25%, wherein the second dose reduces the incidence of hMPV infection by at least 25%, and wherein the third dose reduces the incidence of PIV infection by at least 25%. In certain embodiments, the first dose reduces the incidence of RSV infection by at least 50%, the second dose reduces the incidence of hMPV infection by at least 50%, and the third dose reduces the incidence of PIV infection by at least 50%. In certain embodiments, the first dose reduces the incidence of RSV infection by at least 75%, the second dose reduces the incidence of hMPV infection by at least 75%, and the third dose reduces the incidence of PIV infection by at least 75%. In certain embodiments, the first dose reduces the incidence of RSV infection by at least 90%, the second dose reduces the incidence of hMPV infection by at least 90%, and the third antibody reduces the incidence of PIV infection by at least 90%.

In certain embodiments, the invention provides a method of passive immunotherapy, said method comprising administering to a subject: (i) a first dose of one or more first antibodies or antigen-binding fragments thereof, wherein said one or more first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen; (ii) a second dose of one or more second antibodies or antigen-binding fragments thereof, wherein said one or more second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen; and (iii) a third dose of one or more third antibodies or antigen-binding fragments thereof, wherein said one or more third antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen, wherein the serum titer of said one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering said one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof, wherein the serum titer of said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering said one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof, and wherein the serum titer of said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof. In certain embodiments, the amino acid sequence of the PIV antigen is that of SEQ ID NO:407 to 419, respectively. In certain embodiments, the amino acid sequence of the PIV antigen is 90% identical to the amino acid sequence of PIV nucleoprotein, PIV phosphoprotein, PIV matrix protein, PIV small hydrophobic protein, PIV RNA-dependent RNA polymerase, PIV F protein, or PIV G protein. In certain embodiments, the PIV antigen is selected from the group consisting of PIV nucleoprotein, PIV phosphoprotein, PIV matrix protein, PIV small hydrophobic protein, PIV RNA-dependent RNA polymerase, PIV F protein, and PIV G protein.

In certain embodiments, the invention provides a method of preventing a viral infection in a subject, said method comprising administering to the subject: (i) a prophylactically effective amount of one or more first antibodies or antigen-binding fragments thereof, wherein said one or more first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen; and (ii) a prophylactically effective amount of one or more second antibodies or antigen-binding fragments thereof, wherein said one or more second antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen. In certain embodiments, said one or more anti-RSV-antigen antibodies or

antigen-binding fragments thereof neutralize RSV. In certain embodiments, said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof neutralize PIV. In certain embodiments, said one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof block RSV infection of cells of the subject. In certain embodiments, said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof block PIV infection of cells of the subject.

In certain embodiments, the invention provides a method of treating one or more symptoms of a respiratory viral infection in a subject, said method comprising administering to the subject: (i) a therapeutically effective amount of one or more first antibodies or antigen-binding fragments thereof, wherein said one or more first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen; and (ii) a therapeutically effective amount of one or more second antibodies or antigen-binding fragments thereof, wherein said one or more second antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen.

In certain embodiments, the invention provides a method of passive immunotherapy, said method comprising administering to a subject: (i) a first dose of one or more first antibodies or antigen-binding fragments thereof, wherein said one or more first antibodies or a fragments thereof bind immunospecifically to a RSV antigen; and (ii) a second dose of one or more second antibodies or antigen-binding fragments thereof, wherein said one or more second antibodies or a fragments thereof bind immunospecifically to a PIV antigen, wherein the first dose reduces the incidence of RSV infection by at least 25% and wherein the second dose reduces the incidence of PIV infection by at least 25%. In certain embodiments, the first dose reduces the incidence of RSV infection by at least 50% and wherein the second dose reduces the incidence of hMPV infection by at least 50%. In certain embodiments, the first dose reduces the incidence of RSV infection by at least 75% and wherein the second dose reduces the incidence of hMPV infection by at least 75%. In certain embodiments, the first dose reduces the incidence of RSV infection by at least 90% and wherein the second dose reduces the incidence of hMPV infection by at least 90%.

In certain embodiments, the invention provides a method of passive immunotherapy, said method comprising administering to a subject: (i) a first dose of one or more first antibodies or antigen-binding fragments thereof, wherein said one or more first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen; and (ii) a second dose of one or more second antibodies or antigen-binding fragments thereof, wherein

said one or more second antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen, wherein the serum titer of said one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering said one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof and wherein the serum titer of said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering said one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof.

3.1. BRIEF DESCRIPTION OF THE FIGURES

Figure 1. Expression constructs for the expression of the hMPV F protein.

3.2. DEFINITIONS

The term “analog” of a certain polypeptide as used herein refers to a polypeptide that possesses a similar or identical function as the certain polypeptide or a fragment of the certain polypeptide, the certain polypeptide can be, *e.g.*, an antibody or an antigen-binding fragment thereof, but does not necessarily comprise a similar or identical amino acid sequence to the certain polypeptide or fragment thereof, or possess a similar or identical structure to the certain polypeptide.

A polypeptide that has a similar amino acid sequence to a certain polypeptide refers to a polypeptide that satisfies at least one of the following: (a) a polypeptide having an amino acid sequence that is at least 30%, at least 35%, at least 40%, at least 45%, at least 50%, at least 55%, at least 60%, at least 65%, at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95% or at least 99% identical to the amino acid sequence the certain polypeptide; (b) a polypeptide encoded by a nucleotide sequence that hybridizes under stringent conditions to a nucleotide sequence encoding the certain polypeptide of at least 5 amino acid residues, at least 10 amino acid residues, at least 15 amino acid residues, at least 20 amino acid residues, at least 25 amino acid residues, at least 40 amino acid residues, at least 50 amino acid residues, at least 60 amino residues, at least 70 amino acid residues, at least 80 amino acid residues, at least 90 amino acid residues, at least 100 amino acid residues, at least 125 amino acid residues, or at least 150 amino acid residues; and (c) a polypeptide encoded by a nucleotide sequence that is at least 30%, at least 35%, at least 40%, at least 45%, at least 50%, at least 55%, at least 60%, at least 65%, at least 70%, at least 75%, at least

80%, at least 85%, at least 90%, at least 95% or at least 99% identical to the nucleotide sequence encoding the certain polypeptide. A polypeptide with similar structure to a certain polypeptide refers to a polypeptide that has a similar secondary, tertiary or quaternary structure to a certain polypeptide. The structure of a polypeptide can be determined by methods known to those skilled in the art, including but not limited to, X-ray crystallography, nuclear magnetic resonance, and crystallographic electron microscopy. A certain polypeptide in the context of the present invention can be RSV polypeptide, an APV polypeptide, a hMPV polypeptide, a PIV polypeptide, a fragment of a RSV polypeptide, a fragment of an APV polypeptide, a fragment of a hMPV polypeptide, a fragment of a PIV polypeptide, an antibody that immunospecifically binds to a RSV polypeptide, an antibody that immunospecifically binds to an APV polypeptide, an antibody that immunospecifically binds to a PIV polypeptide, an antibody that immunospecifically binds to a hMPV polypeptide, an antibody fragment that immunospecifically binds to a RSV polypeptide, an antibody fragment that immunospecifically binds to an APV polypeptide, an antibody fragment that immunospecifically binds to a PIV polypeptide, or an antibody fragment that immunospecifically binds to a hMPV polypeptide.

As used herein, the terms “antibody” and “antibodies” refer to monoclonal antibodies, multispecific antibodies (*e.g.*, bi-specific), human antibodies, humanized antibodies, camelised antibodies, chimeric antibodies, single-chain Fvs (scFv), single chain antibodies, synthetic antibodies, single domain antibodies, Fab fragments, F(ab) fragments, disulfide-linked Fvs (sdFv), and anti-idiotypic (anti-Id) antibodies, and epitope-binding fragments of any of the above. In particular, antibodies include immunoglobulin molecules and immunologically active fragments of immunoglobulin molecules, *i.e.*, molecules that contain an antigen binding site. Immunoglobulin molecules can be of any type (*e.g.*, IgG, IgE, IgM, IgD, IgA and IgY), class (*e.g.*, IgG₁, IgG₂, IgG₃, IgG₄, IgA₁ and IgA₂) or subclass.

As used herein, the term “in combination” refers to the use of more than one prophylactic and/or therapeutic agents. The use of the term “in combination” does not restrict the order in which prophylactic and/or therapeutic agents are administered to a subject with a respiratory viral infection. A first prophylactic or therapeutic agent can be administered prior to (*e.g.*, 5 minutes, 15 minutes, 30 minutes, 45 minutes, 1 hour, 2 hours, 4 hours, 6 hours, 12 hours, 24 hours, 48 hours, 72 hours, 96 hours, 1 week, 2 weeks, 3 weeks, 4 weeks, 5 weeks, 6 weeks, 8 weeks, or 12 weeks before), concomitantly with, or subsequent to (*e.g.*, 5 minutes, 15 minutes, 30 minutes, 45 minutes, 1 hour, 2 hours, 4 hours, 6 hours, 12

hours, 24 hours, 48 hours, 72 hours, 96 hours, 1 week, 2 weeks, 3 weeks, 4 weeks, 5 weeks, 6 weeks, 8 weeks, or 12 weeks after) the administration of a second prophylactic or therapeutic agent to a subject which was or is susceptible to a respiratory viral infection. Any additional prophylactic or therapeutic agent can be administered in any order with the other additional prophylactic or therapeutic agents.

As used herein, the term “synergistic” refers to a combination of prophylactic or therapeutic agents which is more effective than the additive effects of any two or more single agents. A synergistic effect of a combination of prophylactic or therapeutic agents permits the use of lower dosages of one or more of the agents and/or less frequent administration of said agents to a subject with a respiratory viral infection. The ability to utilize lower dosages of prophylactic or therapeutic agents and/or to administer said agents less frequently reduces the toxicity associated with the administration of said agents to a subject without reducing the efficacy of said agents in the prevention or treatment of respiratory viral infections. In addition, a synergistic effect can result in improved efficacy of agents in the prevention or treatment of respiratory viral infections. Finally, synergistic effect of a combination of prophylactic or therapeutic agents may avoid or reduce adverse or unwanted side effects associated with the use of any single therapy.

The term “derivative” as used herein refers to a polypeptide that has been altered by the introduction of amino acid residue substitutions, deletions or additions. The term “derivative” refers also to a polypeptide that has been modified, *i.e.*, by the covalent attachment of any type of molecule to the polypeptide. Further modifications are, *inter alia*, glycosylation, acetylation, pegylation, phosphorylation, amidation, derivatization by known protecting/blocking groups, proteolytic cleavage, linkage to a cellular ligand or other protein. Modifications include, *inter alia*, chemical modifications by techniques known to those of skill in the art, *e.g.*, chemical cleavage, acetylation, formylation, synthesis in the presence of tunicamycin, etc. Further, a derivative if a certain polypeptide can be generated by introducing one or more non-classical amino acids into the certain polypeptide. A polypeptide derivative possesses a similar or identical function as the certain polypeptide from which it is derived.

The term “effective neutralizing titer” as used herein refers to the amount of antibody which corresponds to the amount present in the serum of animals (human or cotton rat) that has been shown to be either clinically efficacious (in humans) or to reduce virus by 99% in,

for example, cotton rats. The 99% reduction is defined by a specific challenge of, *e.g.*, 10^3 pfu, 10^4 pfu, 10^5 pfu, 10^6 pfu, 10^7 pfu, 10^8 pfu, or 10^9 pfu of RSV, PIV, and/or hMPV.

The term “epitopes” as used herein refers to a portion of a protein or polypeptide having antigenic and/or immunogenic activity in an animal, preferably a mammal, and most preferably in a human. An epitope having immunogenic activity is a portion of a protein or polypeptide that elicits an antibody response in an animal. An epitope having antigenic activity is a portion of a protein or polypeptide to which an antibody immunospecifically binds as determined by any method well known in the art, for example, by the immunoassays described herein. Antigenic epitopes need not necessarily be immunogenic.

The term “fragment” as used herein refers to a peptide or polypeptide comprising an amino acid sequence of at least 5 contiguous amino acid residues, at least 10 contiguous amino acid residues, at least 15 contiguous amino acid residues, at least 20 contiguous amino acid residues, at least 25 contiguous amino acid residues, at least 40 contiguous amino acid residues, at least 50 contiguous amino acid residues, at least 60 contiguous amino residues, at least 70 contiguous amino acid residues, at least contiguous 80 amino acid residues, at least contiguous 90 amino acid residues, at least contiguous 100 amino acid residues, at least contiguous 125 amino acid residues, at least 150 contiguous amino acid residues, at least contiguous 175 amino acid residues, at least contiguous 200 amino acid residues, or at least contiguous 250 amino acid residues of the amino acid sequence of a polypeptide, protein, or antibody. Preferably, a fragment has the reactive activity of the polypeptide, protein, or antibody.

The term “human infant” as used herein refers to a human less than 24 months, preferably less than 16 months, less than 12 months, less than 6 months, less than 3 months, less than 2 months, or less than 1 month of age. In certain embodiments, the human infant is born at more than 38 weeks of gestational age.

The term “human infant born prematurely” as used herein refers to a human born at less than 40 weeks gestational age, less than 35 weeks gestational age. In specific embodiments, the prematurely born human infant is of between 30-35 weeks of gestational age. In specific embodiments, the prematurely born human infant is of between 35-38 weeks of gestational age. In certain embodiments, the prematurely born infant is of 38 weeks gestational age, preferably, the infant is of less than 38 weeks gestational age.

An “isolated” or “purified” antibody or fragment thereof is substantially free of cellular material or other contaminating proteins from the cell or tissue source from which the

protein is derived, or substantially free of chemical precursors or other chemicals when chemically synthesized. The language “substantially free of cellular material” includes preparations of an antibody or antibody fragment in which the antibody or antibody fragment is separated from cellular components of the cells from which it is isolated or recombinantly produced. Thus, an antibody or antibody fragment that is substantially free of cellular material includes preparations of antibody or antibody fragment having less than about 30%, 20%, 10%, or 5% (by dry weight) of heterologous protein (also referred to herein as a “contaminating protein”). When the antibody or antibody fragment is recombinantly produced, it is also preferably substantially free of culture medium, *i.e.*, culture medium represents less than about 20%, 10%, or 5% of the volume of the protein preparation. When the antibody or antibody fragment is produced by chemical synthesis, it is preferably substantially free of chemical precursors or other chemicals, *i.e.*, it is separated from chemical precursors or other chemicals which are involved in the synthesis of the protein. Accordingly such preparations of the antibody or antibody fragment have less than about 30%, 20%, 10%, 5% (by dry weight) of chemical precursors or compounds other than the antibody or antibody fragment of interest. In a preferred embodiment, antibodies of the invention or fragments thereof are isolated or purified.

An “isolated” nucleic acid molecule is one which is separated from other nucleic acid molecules which are present in the natural source of the nucleic acid molecule. Moreover, an “isolated” nucleic acid molecule, such as a cDNA molecule, can be substantially free of other cellular material, or culture medium when produced by recombinant techniques, or substantially free of chemical precursors or other chemicals when chemically synthesized. In a preferred embodiment, nucleic acid molecules encoding antibodies of the invention or fragments thereof are isolated or purified.

The term “fusion protein” as used herein refers to a polypeptide that comprises an amino acid sequence of an antibody or fragment thereof and an amino acid sequence of a heterologous polypeptide (*e.g.*, a non-anti-RSV antibody, a non-anti-PIV antibody, a non-anti-APV antibody and/or a non-anti-hMPV antibody).

The term “high potency” as used herein refers to antibodies or antigen-binding fragments thereof that exhibit high potency as determined in various assays for biological activity (*e.g.*, neutralization of RSV, APV, hMPV, PIV) such as those described herein. For example, high potency antibodies of the present invention or fragments thereof have an EC₅₀ value less than 0.01 nM, less than 0.025 nM, less than 0.05 nM, less than 0.1 nM, less than

0.25 nM, less than 0.5 nM, less than 0.75 nM, less than 1 nM, less than 1.25 nM, less than 1.5 nM, less than 1.75 nM, or less than 2 nM as measured by a microneutralization assay described herein. Further, high potency antibodies of the present invention or fragments thereof result in at least a 30%, 40%, 50%, 60%, 75%, preferably at least a 95% and more preferably a 99% lower RSV titer, PIV titer, APV titer, and/or hMPV titer in a subject, such as a cotton rat 5 days after challenge with 10^5 pfu relative to a subject, such as a cotton rat, not administered with said antibodies or antibody fragments. In certain embodiments of the invention, high potency antibodies of the present invention or fragments thereof exhibit a high affinity and/or high avidity for one or more RSV antigens, one or more PIV antigens, one or more hMPV antigens, and/or one or more APV antigens (*e.g.*, antibodies or antibody fragments having an affinity of at least $2 \times 10^8 \text{ M}^{-1}$, at least $2.5 \times 10^8 \text{ M}^{-1}$, at least $5 \times 10^8 \text{ M}^{-1}$, at least 10^9 M^{-1} , at least $5 \times 10^9 \text{ M}^{-1}$, at least 10^{10} M^{-1} , at least $5 \times 10^{10} \text{ M}^{-1}$, at least 10^{11} M^{-1} , at least $5 \times 10^{11} \text{ M}^{-1}$, at least 10^{12} M^{-1} , or at least $5 \times 10^{12} \text{ M}^{-1}$ for one or more RSV antigens, one or more PIV antigens, one or more hMPV antigens, and/or one or more APV antigens).

The term “host” as used herein refers to a mammal, preferably a human.

The term “host cell” as used herein refers to the particular subject cell transfected with a nucleic acid molecule and the progeny or potential progeny of such a cell. Progeny of such a cell may not be identical to the parent cell transfected with the nucleic acid molecule due to mutations or environmental influences that may occur in succeeding generations or integration of the nucleic acid molecule into the host cell genome.

In certain embodiments of the invention, a “prophylactically effective serum titer” is the serum titer in a mammal, preferably a human, that reduces the incidence of a respiratory viral infection, particularly a RSV infection, a hMPV infection, a PIV infection, and/or a APV infection in a subject. Preferably, the prophylactically effective serum titer reduces the incidence of RSV infections, hMPV infections, PIV infections, and/or APV infections in a subject with the greatest probability of complications resulting from RSV infection, hMPV infection, PIV infection, and/or APV infection, respectively (*e.g.*, a subject with cystic fibrosis, bronchopulmonary dysplasia, congenital heart disease, congenital immunodeficiency or acquired immunodeficiency, a subject who has had a bone marrow transplant, a human infant, or an elderly human). In certain other embodiments of the invention, a “prophylactically effective serum titer” is the serum titer in a cotton rat that results in a RSV titer, hMPV titer, PIV titer, and/or APV titer 5 days after challenge with 10^5 pfu that is 90%, *i.e.*, 1 log, lower than the RSV titer, hMPV titer, PIV titer, and/or APV titer 5 days after

challenge with 10^5 pfu of RSV, hMPV, APV, and/or PIV, respectively, in a cotton rat not administered an antibody or antibody fragment that immunospecifically binds to a RSV antigen, hMPV antigen, PIV antigen, and/or APV antigen, respectively. A prophylactically effective amount includes an amount that is prophylactically effective in combination with other agents, even if it is not prophylactically effective by itself.

In certain embodiments of the invention, a “therapeutically effective serum titer” is the serum titer in a mammal, preferably a human, that reduces the severity, the duration and/or the symptoms associated with a respiratory viral infection, particularly with a RSV infection, a hMPV infection, an APV infection, and/or a PIV infection in said mammal. Preferably, the therapeutically effective serum titer reduces the severity, the duration and/or the number symptoms associated with RSV infections, hMPV infections, APV infections, and/or PIV infections in humans with the greatest probability of complications resulting from a RSV, APV, hMPV, and/or PIV infection (*e.g.*, a human with cystic fibrosis, bronchopulmonary dysplasia, congenital heart disease, congenital immunodeficiency or acquired immunodeficiency, a human who has had a bone marrow transplant, a human infant, or an elderly human). In certain other embodiments of the invention, a “therapeutically effective serum titer” is the serum titer in a cotton rat that results in a RSV, APV, hMPV, and/or PIV titer 5 days after challenge with 10^5 pfu that is 90%, *i.e.*, 1 log, lower than the RSV, APV, hMPV, and/or PIV titer 5 days after challenge with 10^5 pfu of RSV APV, hMPV, and/or PIV, respectively, in a cotton rat not administered an antibody or antibody fragment that immunospecifically binds to a RSV, APV, hMPV, and/or PIV antigen, respectively. A therapeutically effective amount includes an amount that is therapeutically effective in combination with other agents, even if it is not therapeutically effective by itself.

The term “anti-PIV-antigen antibody” refers to an antibody or antibody fragment thereof that binds immunospecifically to a PIV antigen. A PIV antigen refers to a PIV polypeptide or fragment thereof such as of PIV nucleocapsid structural protein, PIV phosphoprotein, PIV fusion glycoprotein, PIV L protein, PIV matrix protein, PIV HN glycoprotein, PIV RNA-dependent RNA polymerase, PIV Y1 protein, PIV D protein, or PIV C protein. A PIV antigen also refers to a polypeptide that has a similar amino acid sequence compared to a PIV nucleocapsid structural protein, PIV phosphoprotein, PIV fusion glycoprotein, PIV L protein, PIV matrix protein, PIV HN glycoprotein, PIV RNA-dependent RNA polymerase, PIV Y1 protein, PIV D protein, or PIV C protein.

The term “anti-RSV-antigen antibody” refers to an antibody or antibody fragment thereof that binds immunospecifically to a RSV antigen. A RSV antigen refers to a RSV polypeptide or fragment thereof such as of RSV nucleoprotein, RSV phosphoprotein, RSV matrix protein, RSV small hydrophobic protein, RSV RNA-dependent RSV polymerase, RSV F protein, and RSV G protein. A RSV antigen also refers to a polypeptide that has a similar amino acid sequence compared to a RSV polypeptide or fragment thereof such as of RSV nucleoprotein, RSV phosphoprotein, RSV matrix protein, RSV small hydrophobic protein, RSV RNA-dependent RSV polymerase, RSV F protein, and RSV G protein.

The term “anti-hMPV-antigen antibody” refers to an antibody or antibody fragment thereof that binds immunospecifically to a hMPV antigen. A hMPV antigen refers to a hMPV polypeptide or fragment thereof such as of hMPV nucleoprotein, hMPV phosphoprotein, hMPV matrix protein, hMPV small hydrophobic protein, hMPV RNA-dependent hMPV polymerase, hMPV F protein, and hMPV G protein. A hMPV antigen also refers to a polypeptide that has a similar amino acid sequence compared to a hMPV polypeptide or fragment thereof such as of hMPV nucleoprotein, hMPV phosphoprotein, hMPV matrix protein, hMPV small hydrophobic protein, hMPV RNA-dependent hMPV polymerase, hMPV F protein, and hMPV G protein.

The term “serum titer” as used herein refers to an average serum titer in a population of least 10, preferably at least 20, and most preferably at least 40 subjects.

The term “subject” as used herein refers to vertebrate, preferably to a mammal. A subject can be a primate, a rat, a mouse, or a cotton rat. Most preferably, the subject is a human.

As used herein, the terms “immunospecifically binds” and “anti-RSV, anti-hMPV, or anti-PIV antibodies” and analogous terms refer to antibodies or fragments thereof that specifically bind to a RSV antigen, a hMPV antigen, or a PIV antigen in an ELISA assay or any other immuno-assay well-known to the skilled artisan (*e.g.*, as described in section 4.8, *infra*). In certain embodiments, an antibody or fragment thereof that immunospecifically binds to a RSV antigen, a hMPV antigen, or a PIV antigen may bind to other peptides or polypeptides with lower or equal affinity as determined by, *e.g.*, immunoassays, BIAcore, or other assays known in the art. In certain other embodiments, an antibody or fragment thereof that immunospecifically binds to a RSV antigen, a hMPV antigen, or a PIV antigen does not bind to other peptides or polypeptides as determined by, *e.g.*, immunoassays, BIAcore, or other assays known in the art. Antibodies or fragments that immunospecifically bind to a

RSV antigen, a hMPV antigen, or a PIV antigen may be cross-reactive with related antigens. Preferably, antibodies or fragments that immunospecifically bind to a RSV antigen, a hMPV antigen, or a PIV antigen do not cross-react with other antigens. Antibodies or fragments that immunospecifically bind to a RSV antigen, a hMPV antigen, or a PIV antigen can be identified, for example, by immunoassays, BIAcore, or other techniques known to those of skill in the art. In certain embodiments, an antibody or fragment thereof binds specifically to a RSV antigen, a hMPV antigen, or a PIV antigen when it binds to a RSV antigen, a hMPV antigen, or a PIV antigen with higher affinity than to any cross-reactive antigen as determined using experimental techniques, such as, but not limited to, radioimmunoassays (RIA), enzyme-linked immunosorbent assays (ELISAs), BIAcore, or other techniques known to those of skill in the art. See, *e.g.*, Paul, ed., 1989, Fundamental Immunology Second Edition, Raven Press, New York at pages 332-336 for a discussion regarding antibody specificity. In certain embodiments, an antibody or fragment thereof binds specifically to a RSV antigen, a hMPV antigen, or a PIV antigen with equal affinity as to any cross-reactive antigen as determined using experimental techniques, such as radioimmunoassays (RIA) and enzyme-linked immunosorbent assays (ELISAs).

To determine the percent identity of two amino acid sequences or of two nucleic acid sequences, the sequences are aligned for optimal comparison purposes (*e.g.*, gaps can be introduced in the sequence of a first amino acid or nucleic acid sequence for optimal alignment with a second amino acid or nucleic acid sequence). The amino acid residues or nucleotides at corresponding amino acid positions or nucleotide positions are then compared. When a position in the first sequence is occupied by the same amino acid residue or nucleotide as the corresponding position in the second sequence, then the molecules are identical at that position. The percent identity between the two sequences is a function of the number of identical positions shared by the sequences (*i.e.*, % identity = number of identical overlapping positions/total number of positions x 100%). In one embodiment, the two sequences are the same length.

The determination of percent identity between two sequences can also be accomplished using a mathematical algorithm. A preferred, non-limiting example of a mathematical algorithm utilized for the comparison of two sequences is the algorithm of Karlin and Altschul, 1990, Proc. Natl. Acad. Sci. U.S.A. 87:2264-2268, modified as in Karlin and Altschul, 1993, Proc. Natl. Acad. Sci. U.S.A. 90:5873-5877. Such an algorithm is incorporated into the NBLAST and XBLAST programs of Altschul et al., 1990, J. Mol. Biol.

215:403. BLAST nucleotide searches can be performed with the NBLAST nucleotide program parameters set, *e.g.*, for score=100, wordlength=12 to obtain nucleotide sequences homologous to a nucleic acid molecules of the present invention. BLAST protein searches can be performed with the XBLAST program parameters set, *e.g.*, to score=50, wordlength=3 to obtain amino acid sequences homologous to a protein molecule of the present invention. To obtain gapped alignments for comparison purposes, Gapped BLAST can be utilized as described in Altschul et al., 1997, Nucleic Acids Res. 25:3389-3402. Alternatively, PSI-BLAST can be used to perform an iterated search which detects distant relationships between molecules (*Id.*). When utilizing BLAST, Gapped BLAST, and PSI-Blast programs, the default parameters of the respective programs (*e.g.*, of XBLAST and NBLAST) can be used (see, *e.g.*, <http://www.ncbi.nlm.nih.gov>). Another preferred, non-limiting example of a mathematical algorithm utilized for the comparison of sequences is the algorithm of Myers and Miller, 1988, CABIOS 4:11-17. Such an algorithm is incorporated in the ALIGN program (version 2.0) which is part of the GCG sequence alignment software package. When utilizing the ALIGN program for comparing amino acid sequences, a PAM120 weight residue table, a gap length penalty of 12, and a gap penalty of 4 can be used.

The percent identity between two sequences can be determined using techniques similar to those described above, with or without allowing gaps. In calculating percent identity, typically only exact matches are counted.

References to RSV, PIV, hMPV, and APV include all groups, subgroups, isolates, types and strains of the respective virus. In a specific embodiment, RSV, PIV, and hMPV refer to all groups, subgroups, isolates, types and strains of human RSV, PIV, and hMPV, respectively.

ABBREVIATIONS

cDNA	complementary DNA
L	large protein
M	matrix protein (lines inside of envelope)
F	fusion glycoprotein
HN	hemagglutinin-neuraminidase glycoprotein
N, NP or NC	nucleoprotein (associated with RNA and required for polymerase activity)
P	phosphoprotein
MOI	multiplicity of infection

NA	neuraminidase (envelope glycoprotein)
PIV	parainfluenza virus
nt	nucleotide
hMPV	human metapneumovirus
APV	avian pneumovirus

4. DETAILED DESCRIPTION OF THE INVENTION

4.1 ANTIBODIES

The invention provides methods of passive immunotherapy for broad-spectrum prevention and, in certain embodiments, treatment of viral respiratory infection. The antibodies to be used with the methods of the invention include antibodies or antigen-binding fragments thereof that bind immunospecifically to a RSV antigen, antibodies or antigen-binding fragments thereof that bind immunospecifically to a hMPV antigen, antibodies or antigen-binding fragments thereof that bind immunospecifically to a PIV antigen, and, in a specific embodiment, human or humanized antibodies that bind immunospecifically to a hMPV antigen and that cross-react with an APV antigen. In a specific embodiment, the antibody to be used with the methods of the invention is an antibody that binds immunospecifically to a hMPV antigen and that cross-reacts with a turkey APV antigen. In a specific embodiment, the antibody to be used with the methods of the invention is a human or humanized antibody that binds immunospecifically to a hMPV antigen and that cross-reacts with a turkey APV antigen. In other specific embodiments, the anti-hMPV antibody does not react with a turkey APV antigen or an APV antigen from any other species of APV.

In certain embodiments, fragments of viral antigens are used as immunogen to produce antibodies to be used with the methods of the invention. In certain embodiments, fragments preferably contain a sequence of at least 4, at least 5, at least 6, at least 7, more preferably at least 8, at least 9, at least 10, at least 11, at least 12, at least 13, at least 14, at least 15, at least 20, at least 25, at least 30, at least 40, at least 50, at least 75 or at least 100 amino acids. In certain, more specific embodiments, a fragment is about 15 to about 30 amino acids long. Preferred polypeptides comprising immunogenic or antigenic epitopes are at least 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, or 100 amino acid residues in length. Additional non-exclusive preferred antigenic epitopes include the antigenic epitopes disclosed herein, as well as portions thereof.

In certain embodiments, the anti-PIV-antigen antibody, the anti-RSV-antigen antibody, and/or the anti-hMPV-antigen antibody inhibit the binding of a virus that causes respiratory infection to a cell. In certain embodiments, the anti-PIV-antigen antibody, the anti-RSV-antigen antibody, and/or the anti-hMPV-antigen antibody inhibit in a subject the binding of a virus that causes respiratory infection to a cell of the subject. In certain embodiments, the anti-PIV-antigen antibody, the anti-RSV-antigen antibody, and/or the anti-hMPV-antigen antibody inhibit the infection of a subject with a virus that causes respiratory infections. In certain embodiments, the anti-PIV-antigen antibody, the anti-RSV-antigen antibody, and/or the anti-hMPV-antigen antibody cause neutralization of the virus that causes respiratory infections.

The antibodies to be used with the methods of the invention bind immunospecifically to a variety of viral antigens as discussed in sections 4.1.5, 4.1.6, and 4.1.7 below. In certain embodiments, at least one antibody to be used with the methods of the invention binds immunospecifically to an epitope of an antigen of PIV, hMPV, or RSV, and cross-reacts with another epitope on the same antigen of PIV, hMPV, or RSV, respectively. In certain embodiments, at least one antibody to be used with the methods of the invention binds immunospecifically to an epitope of an antigen of PIV, hMPV, or RSV, and cross-reacts with the analogous antigen of a different virus. For example, an antibody that binds immunospecifically to the F protein of RSV cross reacts with the F protein of hMPV. In a specific embodiment, the anti-RSV-antigen antibody is SYNAGIS®. SYNAGIS® is also known as Palivizumab. The amino acid sequence of SYNAGIS® (Palivizumab) is disclosed in International Application Publication WO 02/43660, entitled "Methods of Administering/Dosing Anti-RSV Antibodies for Prophylaxis and Treatment", by Young et al., which is incorporated herein by reference in its entirety. In another specific embodiment, the anti-RSV-antigen antibody is not SYNAGIS®. In certain specific embodiments, the anti-RSV-antigen antibody is AFFF; P12f2 P12f4; P11d4; Ale9; A12a6; A13c4; A17d4; A4B4; 1X-493L1; FR H3-3F4; M3H9; Y10H6; DG; AFFF(1); 6H8; L1-7E5; L2-15B10; A13a11; A1h5; A4B4(1); A4B4-F52S; or A4B4L1FR-S28R. These antibodies are disclosed in International Application Publication No.: WO 02/43660, entitled "Methods of Administering/Dosing Anti-RSV Antibodies for Prophylaxis and Treatment", by Young et al., which is incorporated herein by reference in its entirety.

In certain embodiments, at least one antibody to be used with the methods of the invention binds immunospecifically to an antigen of one subgroup (type, subtype, group,

isolate etc.) of PIV, hMPV, or RSV and to the analogous antigen of another subgroup (type, subtype, group, isolate etc.) of PIV, hMPV, or RSV, respectively (see sections 4.1.5, 4.1.6, and 4.1.7, respectively).

Antibodies of the invention include, but are not limited to, monoclonal antibodies, multispecific antibodies, synthetic antibodies, human antibodies, humanized antibodies, chimeric antibodies, single-chain Fvs (scFv), single chain antibodies, Fab fragments, F(ab') fragments, disulfide-linked Fvs (sdFv), and anti-idiotypic (anti-Id) antibodies (including, *e.g.*, anti-Id antibodies to antibodies of the invention), and epitope-binding fragments of any of the above. In particular, antibodies of the present invention include immunoglobulin molecules and immunologically active portions of immunoglobulin molecules, *i.e.*, molecules that contain an antigen binding site that immunospecifically binds to a RSV, PIV, APV, and/or hMPV antigen. The immunoglobulin molecules of the invention can be of any type (*e.g.*, IgG, IgE, IgM, IgD, IgA and IgY), class (*e.g.*, IgG₁, IgG₂, IgG₃, IgG₄, IgA₁ and IgA₂) or subclass of immunoglobulin molecule.

The antibodies of the invention may be from any animal origin including birds and mammals (*e.g.*, human, murine, donkey, sheep, rabbit, goat, guinea pig, camel, horse, or chicken). Preferably, the antibodies of the invention are human or humanized monoclonal antibodies. As used herein, "human" antibodies include antibodies having the amino acid sequence of a human immunoglobulin and include antibodies isolated from human immunoglobulin libraries (including, but not limited to, synthetic libraries of immunoglobulin sequences homologous to human immunoglobulin sequences) or from mice that express antibodies from human genes.

The antibodies of the present invention may be monospecific, bispecific, trispecific or of greater multispecificity. Multispecific antibodies may be specific for different epitopes of one antigen of RSV, PIV, or hMPV. In certain embodiments, multispecific antibodies are specific for more than one antigen of RSV, PIV, or hMPV. In certain embodiments, multispecific antibodies are specific for an antigen of RSV and an antigen of hMPV. In certain embodiments, multispecific antibodies are specific for an antigen of PIV and an antigen of hMPV. In certain embodiments, multispecific antibodies are specific for an antigen of PIV and an antigen of RSV. In certain embodiments, multispecific antibodies are specific for an antigen of RSV, an antigen of PIV, and an antigen of hMPV. For multispecific antibodies see, *e.g.*, PCT publications WO 93/17715, WO 92/08802, WO 91/00360, and WO 92/05793; Tutt, et al., J. Immunol. 147:60-69(1991); U.S. Patent Nos.

4,474,893, 4,714,681, 4,925,648, 5,573,920, and 5,601,819; and Kostelny et al., J. Immunol. 148:1547-1553 (1992).

In certain embodiments, high potency antibodies can be used in the methods of the invention. For example, high potency antibodies can be produced by genetically engineering appropriate antibody gene sequences and expressing the antibody sequences in a suitable host. The antibodies produced can be screened to identify antibodies with, *e.g.*, high k_{on} values in a BIAcore assay (see section 4.8.3).

In certain embodiments, an antibody to be used with the methods of the present invention or fragment thereof has an affinity constant or K_a (k_{on}/k_{off}) of at least $10^2 M^{-1}$, at least $5 \times 10^2 M^{-1}$, at least $10^3 M^{-1}$, at least $5 \times 10^3 M^{-1}$, at least $10^4 M^{-1}$, at least $5 \times 10^4 M^{-1}$, at least $10^5 M^{-1}$, at least $5 \times 10^5 M^{-1}$, at least $10^6 M^{-1}$, at least $5 \times 10^6 M^{-1}$, at least $10^7 M^{-1}$, at least $5 \times 10^7 M^{-1}$, at least $10^8 M^{-1}$, at least $5 \times 10^8 M^{-1}$, at least $10^9 M^{-1}$, at least $5 \times 10^9 M^{-1}$, at least $10^{10} M^{-1}$, at least $5 \times 10^{10} M^{-1}$, at least $10^{11} M^{-1}$, at least $5 \times 10^{11} M^{-1}$, at least $10^{12} M^{-1}$, at least $5 \times 10^{12} M^{-1}$, at least $10^{13} M^{-1}$, at least $5 \times 10^{13} M^{-1}$, at least $10^{14} M^{-1}$, at least $5 \times 10^{14} M^{-1}$, at least $10^{15} M^{-1}$, or at least $5 \times 10^{15} M^{-1}$. In yet another embodiment, an antibody to be used with the methods of the invention or fragment thereof has a dissociation constant or K_d (k_{off}/k_{on}) of less than $10^{-2} M$, less than $5 \times 10^{-2} M$, less than $10^{-3} M$, less than $5 \times 10^{-3} M$, less than $10^{-4} M$, less than $5 \times 10^{-4} M$, less than $10^{-5} M$, less than $5 \times 10^{-5} M$, less than $10^{-6} M$, less than $5 \times 10^{-6} M$, less than $10^{-7} M$, less than $5 \times 10^{-7} M$, less than $10^{-8} M$, less than $5 \times 10^{-8} M$, less than $10^{-9} M$, less than $5 \times 10^{-9} M$, less than $10^{-10} M$, less than $5 \times 10^{-10} M$, less than $10^{-11} M$, less than $5 \times 10^{-11} M$, less than $10^{-12} M$, less than $5 \times 10^{-12} M$, less than $10^{-13} M$, less than $5 \times 10^{-13} M$, less than $10^{-14} M$, less than $5 \times 10^{-14} M$, less than $10^{-15} M$, or less than $5 \times 10^{-15} M$.

In certain embodiments, an antibody to be used with the methods of the invention or fragment thereof that has a median effective concentration (EC_{50}) of less than 0.01 nM, less than 0.025 nM, less than 0.05 nM, less than 0.1 nM, less than 0.25 nM, less than 0.5 nM, less than 0.75 nM, less than 1 nM, less than 1.25 nM, less than 1.5 nM, less than 1.75 nM, or less than 2 nM, in an *in vitro* microneutralization assay. The median effective concentration is the concentration of antibody or antibody fragments that neutralizes 50% of the RSV in an *in vitro* microneutralization assay. In a preferred embodiment, an antibody to be used with the methods of the invention or fragment thereof has an EC_{50} of less than 0.01 nM, less than 0.025 nM, less than 0.05 nM, less than 0.1 nM, less than 0.25 nM, less than 0.5 nM, less

than 0.75 nM, less than 1 nM, less than 1.25 nM, less than 1.5 nM, less than 1.75 nM, or less than 2 nM, in an *in vitro* microneutralization assay.

In certain embodiments, the antibodies to be used with the methods of the invention are derivatives of anti-RSV antigen, anti-PIV antigen, and/or anti-hMPV antigen antibodies. Standard techniques known to those of skill in the art can be used to introduce mutations in the nucleotide sequence encoding an antibody to be used with the methods of the invention, including, for example, site-directed mutagenesis and PCR-mediated mutagenesis which result in amino acid substitutions. Preferably, the derivatives include less than 25 amino acid substitutions, less than 20 amino acid substitutions, less than 15 amino acid substitutions, less than 10 amino acid substitutions, less than 5 amino acid substitutions, less than 4 amino acid substitutions, less than 3 amino acid substitutions, or less than 2 amino acid substitutions relative to the original molecule. In a preferred embodiment, the derivatives have conservative amino acid substitutions are made at one or more predicted non-essential amino acid residues. A "conservative amino acid substitution" is one in which the amino acid residue is replaced with an amino acid residue having a side chain with a similar charge. Families of amino acid residues having side chains with similar charges have been defined in the art. These families include amino acids with basic side chains (*e.g.*, lysine, arginine, histidine), acidic side chains (*e.g.*, aspartic acid, glutamic acid), uncharged polar side chains (*e.g.*, glycine, asparagine, glutamine, serine, threonine, tyrosine, cysteine), nonpolar side chains (*e.g.*, alanine, valine, leucine, isoleucine, proline, phenylalanine, methionine, tryptophan), beta-branched side chains (*e.g.*, threonine, valine, isoleucine) and aromatic side chains (*e.g.*, tyrosine, phenylalanine, tryptophan, histidine). Alternatively, mutations can be introduced randomly along all or part of the coding sequence, such as by saturation mutagenesis, and the resultant mutants can be screened for biological activity to identify mutants that retain activity. Following mutagenesis, the encoded protein can be expressed and the activity of the protein can be determined.

The antibodies to be used with the methods of the invention include derivatives that are modified, *i.e.*, by the covalent attachment of any type of molecule to the antibody such that covalent attachment. For example, but not by way of limitation, the antibody derivatives include antibodies that have been modified, *e.g.*, by glycosylation, acetylation, pegylation, phosphorylation, amidation, derivatization by known protecting/blocking groups, proteolytic cleavage, linkage to a cellular ligand or other protein, etc. Any of numerous chemical modifications may be carried out by known techniques, including, but not limited to specific

chemical cleavage, acetylation, formylation, synthesis in the presence of tunicamycin, etc. Additionally, the derivative may contain one or more non-classical amino acids.

The present invention also provides antibodies of the invention or fragments thereof that comprise a framework region known to those of skill in the art. In certain embodiments, one or more framework regions, preferably, all of the framework regions, of an antibody to be used in the methods of the invention or fragment thereof are human. In certain other embodiments of the invention, the fragment region of an antibody of the invention or fragment thereof is humanized. In certain embodiments, the antibody to be used with the methods of the invention is a synthetic antibody, a monoclonal antibody, an intrabody, a chimeric antibody, a human antibody, a humanized chimeric antibody, a humanized antibody, a glycosylated antibody, a multispecific antibody, a human antibody, a single-chain antibody, or a bispecific antibody.

In certain embodiments of the invention, the antibodies to be used with the invention have half-lives in a mammal, preferably a human, of greater than 12 hours, greater than 1 day, greater than 3 days, greater than 6 days, greater than 10 days, greater than 15 days, greater than 20 days, greater than 25 days, greater than 30 days, greater than 35 days, greater than 40 days, greater than 45 days, greater than 2 months, greater than 3 months, greater than 4 months, or greater than 5 months. Antibodies or antigen-binding fragments thereof having increased *in vivo* half-lives can be generated by techniques known to those of skill in the art. For example, antibodies or antigen-binding fragments thereof with increased *in vivo* half-lives can be generated by modifying (*e.g.*, substituting, deleting or adding) amino acid residues identified as involved in the interaction between the Fc domain and the FcRn receptor (see, *e.g.*, PCT Publication No. WO 97/34631 and U.S. Patent Application No.: 10/020,354, entitled "Molecules with Extended Half-Lives, Compositions and Uses Thereof", filed December 12, 2001, by Johnson et al., which are incorporated herein by reference in their entireties). Such antibodies or antigen-binding fragments thereof can be tested for binding activity to RSV antigens as well as for *in vivo* efficacy using methods known to those skilled in the art, for example, by immunoassays described herein.

Further, antibodies or antigen-binding fragments thereof with increased *in vivo* half-lives can be generated by attaching to said antibodies or antibody fragments polymer molecules such as high molecular weight polyethyleneglycol (PEG). PEG can be attached to said antibodies or antibody fragments with or without a multifunctional linker either through site-specific conjugation of the PEG to the N- or C- terminus of said antibodies or antibody

fragments or via epsilon-amino groups present on lysine residues. Linear or branched polymer derivatization that results in minimal loss of biological activity will be used. The degree of conjugation will be closely monitored by SDS-PAGE and mass spectrometry to ensure proper conjugation of PEG molecules to the antibodies. Unreacted PEG can be separated from antibody-PEG conjugates by, *e.g.*, size exclusion or ion-exchange chromatography. PEG-derivatized antibodies or antigen-binding fragments thereof can be tested for binding activity to RSV antigens as well as for *in vivo* efficacy using methods known to those skilled in the art, for example, by immunoassays described herein.

In certain embodiments, the antibodies to be used with the methods of the invention are fusion proteins comprising an antibody or fragment thereof that immunospecifically binds to a RSV, PIV, and/or hMPV antigen and a heterologous polypeptide. Preferably, the heterologous polypeptide that the antibody or antibody fragment is fused to is useful for targeting the antibody to respiratory epithelial cells.

In certain embodiments, antibodies to be used with the methods of the invention or fragments thereof disrupt or prevent the interaction between a RSV antigen, a PIV antigen, and/or a hMPV antigen and its host cell receptor.

In certain embodiments, antibodies to be used with the methods of the invention are single-chain antibodies. The design and construction of a single-chain antibody is described in Marasco et al, 1993, Proc Natl Acad Sci 90:7889-7893, which is incorporated herein by reference in its entirety.

In certain embodiments, the antibodies to be used with the invention binds to an intracellular epitope, *i.e.*, are intrabodies. An intrabody comprises at least a portion of an antibody that is capable of immunospecifically binding an antigen and preferably does not contain sequences coding for its secretion. Such antibodies will bind its antigen intracellularly. In one embodiment, the intrabody comprises a single-chain Fv ("sFv"). sFv are antibody fragments comprising the V_H and V_L domains of antibody, wherein these domains are present in a single polypeptide chain. Generally, the Fv polypeptide further comprises a polypeptide linker between the V_H and V_L domains which enables the sFv to form the desired structure for antigen binding. For a review of sFv see Pluckthun in *The Pharmacology of Monoclonal Antibodies*, vol. 113, Rosenberg and Moore eds. Springer-Verlag, New York, pp. 269-315 (1994). In a further embodiment, the intrabody preferably does not encode an operable secretory sequence and thus remains within the cell (see

generally Marasco, WA, 1998, "Intrabodies: Basic Research and Clinical Gene Therapy Applications" Springer:New York).

Generation of intrabodies is well-known to the skilled artisan and is described for example in U.S. Patent Nos. 6,004,940; 6,072,036; 5,965,371, which are incorporated by reference in their entireties herein. Further, the construction of intrabodies is discussed in Ohage and Steipe, 1999, J. Mol. Biol. 291:1119-1128; Ohage et al., 1999, J. Mol. Biol. 291:1129-1134; and Wirtz and Steipe, 1999, Protein Science 8:2245-2250, which references are incorporated herein by reference in their entireties. Recombinant molecular biological techniques such as those described for recombinant production of antibodies (*e.g.*, Section 4.1.2 and 4.1.3) may also be used in the generation of intrabodies. A discussion of intrabodies as antiviral agents can also be found in Marasco, 2001, Curr. Top. Microbiol. Immunol. 260:247-270, which is incorporated by reference herein in its entirety.

In particular, the invention provides methods for treating, preventing, and/or ameliorating one or more symptoms of a respiratory infection by administering either: (i) one or more anti-RSV-antigen intrabodies or fragments thereof and one or more anti-PIV-antigen intrabodies or fragments thereof; (ii) one or more anti-PIV-antigen intrabodies or fragments thereof and one or more anti-hMPV-antigen intrabodies or fragments thereof; or (iii) one or more anti-RSV-antigen intrabodies or fragments thereof, one or more anti-PIV-antigen intrabodies or fragments thereof, and one or more anti-hMPV-antigen intrabodies or fragments thereof. The invention also encompasses administering combinations of intrabodies and antibodies or antigen-binding fragments thereof. For example, but not by way of limitation, a method of the invention comprises administering one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof and one or more anti-hMPV-antigen intrabodies or fragments thereof.

In one embodiment, intrabodies of the invention retain at least about 75% of the binding effectiveness of the complete antibody (*i.e.*, having constant as well as variable regions) to the antigen. More preferably, the intrabody retains at least 85% of the binding effectiveness of the complete antibody. Still more preferably, the intrabody retains at least 90% of the binding effectiveness of the complete antibody. Even more preferably, the intrabody retains at least 95% of the binding effectiveness of the complete antibody.

In producing intrabodies, polynucleotides encoding variable region for both the V_H and V_L chains of interest can be cloned by using, for example, hybridoma mRNA or splenic mRNA as a template for PCR amplification of such domains (Huse et al., 1989, *Science*

246:1276). In one preferred embodiment, the polynucleotides encoding the V_H and V_L domains are joined by a polynucleotide sequence encoding a linker to make a single chain antibody (sFv). The sFv typically comprises a single peptide with the sequence V_H -linker- V_L or V_L -linker- V_H . The linker is chosen to permit the heavy chain and light chain to bind together in their proper conformational orientation (see for example, Huston, et al., 1991, *Methods in Enzym.* 203:46-121, which is incorporated herein by reference). In a further embodiment, the linker can span the distance between its points of fusion to each of the variable domains (e.g., 3.5 nm) to minimize distortion of the native Fv conformation. In such an embodiment, the linker is a polypeptide of at least 5 amino acid residues, at least 10 amino acid residues, at least 15 amino acid residues, or greater. In a further embodiment, the linker should not cause a steric interference with the V_H and V_L domains of the combining site. In such an embodiment, the linker is 35 amino acids or less, 30 amino acids or less, or 25 amino acids or less. Thus, in a most preferred embodiment, the linker is between 15-25 amino acid residues in length. In a further embodiment, the linker is hydrophilic and sufficiently flexible such that the V_H and V_L domains can adopt the conformation necessary to detect antigen. Intrabodies can be generated with different linker sequences inserted between identical V_H and V_L domains. A linker with the appropriate properties for a particular pair of V_H and V_L domains can be determined empirically by assess the degree of antigen binding for each. Examples of linkers include, but are not limited to, those sequences disclosed in Table 1.

Table 1

Sequence(Gly Gly Gly Gly Ser)₃

Glu Ser Gly Arg Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser

Glu Gly Lys Ser Ser Gly Ser Gly Ser Glu Ser Lys Ser Thr

Glu Gly Lys Ser Ser Gly Ser Gly Ser Glu Ser Lys Ser Thr Gln

Glu Gly Lys Ser Ser Gly Ser Gly Ser Glu Ser Lys Val Asp

Gly Ser Thr Ser Gly Ser Gly Lys Ser Ser Glu Gly Lys Gly

Lys Glu Ser Gly Ser Val Ser Ser Glu Gln Leu Ala Gln Phe Arg Ser Leu Asp

Glu Ser Gly Ser Val Ser Ser Glu Glu Leu Ala Phe Arg Ser Leu Asp

In one embodiment, intrabodies are expressed in the cytoplasm. In other embodiments, the intrabodies are localized to various intracellular locations. In such

embodiments, specific localization sequences can be attached to the intranucleotide polypeptide to direct the intrabody to a specific location. Intrabodies can be localized, for example, to the following intracellular locations: endoplasmic reticulum (Munro et al., 1987, *Cell* 48:899-907; Hangejorden et al., 1991, *J. Biol. Chem.* 266:6015); nucleus (Lanford et al., 1986, *Cell* 46:575; Stanton et al., 1986, *PNAS* 83:1772; Harlow et al., 1985, *Mol. Cell Biol.* 5:1605); nucleolar region (Seomi et al., 1990, *J. Virology* 64:1803; Kubota et al., 1989, *Biochem. Biophys. Res. Comm.* 162:963; Siomi et al., 1998, *Cell* 55:197); endosomal compartment (Bakke et al., 1990, *Cell* 63:707-716); mitochondrial matrix (Pugsley, A. P., 1989, "Protein Targeting", Academic Press, Inc.); Golgi apparatus (Tang et al., 1992, *J. Bio. Chem.* 267:10122-6); liposomes (Letourneur et al., 1992, *Cell* 69:1183); and plasma membrane (Marchildon et al., 1984, *PNAS* 81:7679-82; Henderson et al., 1987, *PNAS* 89:339-43; Rhee et al., 1987, *J. Virol.* 61:1045-53; Schultz et al., 1984, *J. Virol.* 133:431-7; Ootsuyama et al., 1985, *Jpn. J. Can. Res.* 76:1132-5; Ratner et al., 1985, *Nature* 313:277-84). Examples of localization signals include, but are not limited to, those sequences disclosed in Table 2.

Table 2

Localization	Sequence
endoplasmic reticulum	Lys Asp Glu Leu
endoplasmic reticulum	Asp Asp Glu Leu
endoplasmic reticulum	Asp Glu Glu Leu
endoplasmic reticulum	Gln Glu Asp Leu
endoplasmic reticulum	Arg Asp Glu Leu
nucleus	Pro Lys Lys Lys Arg Lys Val
nucleus	Pro Gln Lys Lys Ile Lys Ser
nucleus	Gln Pro Lys Lys Pro
nucleus	Arg Lys Lys Arg
nucleolar region	Arg Lys Lys Arg Arg Gln Arg Arg Arg Ala His Gln
nucleolar region	Arg Gln Ala Arg Arg Asn Arg Arg Arg Arg Trp Arg Glu Arg Gln Arg
nucleolar region	Met Pro Leu Thr Arg Arg Arg Pro Ala Ala Ser Gln Ala Leu Ala Pro Pro Thr Pro
endosomal compartment	Met Asp Asp Gln Arg Asp Leu Ile Ser

Localization	Sequence
	Asn Asn Glu Gln Leu Pro
mitochondrial matrix	Met Leu Phe Asn Leu Arg Xaa Xaa Leu Asn Asn Ala Ala Phe Arg His Gly His Asn Phe Met Val Arg Asn Phe Arg Cys Gly Gln Pro Leu Xaa
plasma membrane	GCVCSSNP
plasma membrane	GQTVTTPL
plasma membrane	GQELSQHE
plasma membrane	GNSPSYNP
plasma membrane	GVSGSKGQ
plasma membrane	GQTITTPL
plasma membrane	GQTLTTPL
plasma membrane	GQIFSRSA
plasma membrane	GQIHGLSP
plasma membrane	GARASVLS
plasma membrane	GCTLSAEE

V_H and V_L domains are made up of the immunoglobulin domains that generally have a conserved structural disulfide bond. In embodiments where the intrabodies are expressed in a reducing environment (*e.g.*, the cytoplasm), such a structural feature cannot exist. Mutations can be made to the intrabody polypeptide sequence to compensate for the decreased stability of the immunoglobulin structure resulting from the absence of disulfide bond formation. In one embodiment, the V_H and/or V_L domains of the intrabodies contain one or more point mutations such that their expression is stabilized in reducing environments (see Steipe et al., 1994, *J. Mol. Biol.* 240:188-92; Wirtz and Steipe, 1999, *Protein Science* 8:2245-50; Ohage and Steipe, 1999, *J. Mol. Biol.* 291:1119-28; Ohage et al., 1999, *J. Mol. Biol.* 291:1129-34).

4.1.1 METHODS FOR PRODUCING ANTIBODIES

The antibodies to be used with the methods of the invention or fragments thereof can be produced by any method known in the art for the synthesis of antibodies, in particular, by chemical synthesis or preferably, by recombinant expression techniques.

Polyclonal antibodies to a RSV, PIV, and/or hMPV antigen can be produced by various procedures well known in the art. For example, a RSV, PIV, and/or hMPV antigen can be administered to various host animals including, but not limited to, rabbits, mice, rats, etc. to induce the production of sera containing polyclonal antibodies specific for the RSV, PIV, and/or hMPV antigen. Various adjuvants may be used to increase the immunological response, depending on the host species, and include but are not limited to, Freund's (complete and incomplete), mineral gels such as aluminum hydroxide, surface active substances such as lysolecithin, pluronic polyols, polyanions, peptides, oil emulsions, keyhole limpet hemocyanins, dinitrophenol, and potentially useful human adjuvants such as BCG (bacille Calmette-Guerin) and corynebacterium parvum. Such adjuvants are also well known in the art.

Monoclonal antibodies can be prepared using a wide variety of techniques known in the art including the use of hybridoma, recombinant, and phage display technologies, or a combination thereof. For example, monoclonal antibodies can be produced using hybridoma techniques including those known in the art and taught, for example, in Harlow *et al.*, *Antibodies: A Laboratory Manual*, (Cold Spring Harbor Laboratory Press, 2nd ed. 1988); Hammerling, *et al.*, in: *Monoclonal Antibodies and T-Cell Hybridomas* 563-681 (Elsevier, N.Y., 1981) (said references incorporated by reference in their entireties). The term "monoclonal antibody" as used herein is not limited to antibodies produced through hybridoma technology. The term "monoclonal antibody" refers to an antibody that is derived from a single clone, including any eukaryotic, prokaryotic, or phage clone, and not the method by which it is produced.

Methods for producing and screening for specific antibodies using hybridoma technology are routine and well known in the art. Briefly, mice can be immunized with a RSV, PIV, and/or hMPV antigen and once an immune response is detected, *e.g.*, antibodies specific for the RSV, PIV, and/or hMPV antigen are detected in the mouse serum, the mouse spleen is harvested and splenocytes isolated. The splenocytes are then fused by well known techniques to any suitable myeloma cells, for example cells from cell line SP20 available from the ATCC. Hybridomas are selected and cloned by limited dilution. The hybridoma clones are then assayed by methods known in the art for cells that secrete antibodies capable of binding a polypeptide of the invention. Ascites fluid, which generally contains high levels of antibodies, can be generated by immunizing mice with positive hybridoma clones.

In a specific embodiment, an antigen of APV is used to generate antibodies against hMPV.

In certain embodiments, a method of generating monoclonal antibodies comprises culturing a hybridoma cell secreting an antibody of the invention wherein, preferably, the hybridoma is generated by fusing splenocytes isolated from a mouse immunized with a RSV, PIV, and/or hMPV antigen with myeloma cells and then screening the hybridomas resulting from the fusion for hybridoma clones that secrete an antibody able to bind a RSV, PIV, and/or hMPV antigen.

Antibody fragments which recognize specific RSV, PIV, and/or hMPV epitopes may be generated by any technique known to those of skill in the art. For example, Fab and F(ab')₂ fragments of the invention may be produced by proteolytic cleavage of immunoglobulin molecules, using enzymes such as papain (to produce Fab fragments) or pepsin (to produce F(ab')₂ fragments). F(ab')₂ fragments contain the variable region, the light chain constant region and the CH1 domain of the heavy chain. Further, the antibodies to be used with the present invention can also be generated using various phage display methods known in the art.

In phage display methods, functional antibody domains are displayed on the surface of phage particles which carry the polynucleotide sequences encoding them. In particular, DNA sequences encoding VH and VL domains are amplified from animal cDNA libraries (e.g., human or murine cDNA libraries of lymphoid tissues). The DNA encoding the VH and VL domains are recombined together with an scFv linker by PCR and cloned into a phagemid vector (e.g., p CANTAB 6 or pComb 3 HSS). The vector is electroporated in *E. coli* and the *E. coli* is infected with helper phage. Phage used in these methods are typically filamentous phage including fd and M13 and the VH and VL domains are usually recombinantly fused to either the phage gene III or gene VIII. Phage expressing an antigen binding domain that binds to a RSV, PIV, and/or hMPV antigen of interest can be selected or identified with antigen, e.g., using labeled antigen or antigen bound or captured to a solid surface or bead. Examples of phage display methods that can be used to make the antibodies of the present invention include those disclosed in Brinkman et al., 1995, J. Immunol. Methods 182:41-50; Ames et al., 1995, J. Immunol. Methods 184:177-186; Kettleborough et al., 1994, Eur. J. Immunol. 24:952-958; Persic et al., 1997, Gene 187:9-18; Burton et al., 1994, Advances in Immunology 57:191-280; PCT application No. PCT/GB91/O1 134; PCT publication Nos. WO 90/02809, WO 91/10737, WO 92/01047, WO 92/18619, WO 93/1 1236, WO 95/15982,

WO 95/20401, and WO97/13844; and U.S. Patent Nos. 5,698,426, 5,223,409, 5,403,484, 5,580,717, 5,427,908, 5,750,753, 5,821,047, 5,571,698, 5,427,908, 5,516,637, 5,780,225, 5,658,727, 5,733,743 and 5,969,108; each of which is incorporated herein by reference in its entirety.

As described in the above references, after phage selection, the antibody coding regions from the phage can be isolated and used to generate whole antibodies, including human antibodies, or any other desired antigen binding fragment, and expressed in any desired host, including mammalian cells, insect cells, plant cells, yeast, and bacteria, *e.g.*, as described below. Techniques to recombinantly produce Fab, Fab' and F(ab')₂ fragments can also be employed using methods known in the art such as those disclosed in PCT publication No. WO 92/22324; Mullinax et al., 1992, BioTechniques 12(6):864-869; Sawai et al., 1995, AJRI 34:26-34; and Better et al., 1988, Science 240:1041-1043 (said references incorporated by reference in their entireties).

To generate whole antibodies, PCR primers including VH or VL nucleotide sequences, a restriction site, and a flanking sequence to protect the restriction site can be used to amplify the VH or VL sequences in scFv clones. Utilizing cloning techniques known to those of skill in the art, the PCR amplified VH domains can be cloned into vectors expressing a VH constant region, *e.g.*, the human gamma 4 constant region, and the PCR amplified VL domains can be cloned into vectors expressing a VL constant region, *e.g.*, human kappa or lambda constant regions. Preferably, the vectors for expressing the VH or VL domains comprise an EF-1 α promoter, a secretion signal, a cloning site for the variable domain, constant domains, and a selection marker such as neomycin. The VH and VL domains may also be cloned into one vector expressing the necessary constant regions. The heavy chain conversion vectors and light chain conversion vectors are then co-transfected into cell lines to generate stable or transient cell lines that express full-length antibodies, *e.g.*, IgG, using techniques known to those of skill in the art.

For some uses, including *in vivo* use of antibodies in humans and *in vitro* detection assays, it may be preferable to use human or chimeric antibodies. Completely human antibodies are particularly desirable for therapeutic treatment of human subjects. Human antibodies can be made by a variety of methods known in the art including phage display methods described above using antibody libraries derived from human immunoglobulin sequences or synthetic sequences homologous to human immunoglobulin sequences. See also U.S. Patent Nos. 4,444,887 and 4,716,111; and PCT publications WO 98/46645, WO

98/50433, WO 98/24893, WO98/16654, WO 96/34096, WO 96/33735, and WO 91/10741; each of which is incorporated herein by reference in its entirety.

Human antibodies can also be produced using transgenic mice which are incapable of expressing functional endogenous immunoglobulins, but which can express human immunoglobulin genes. For example, the human heavy and light chain immunoglobulin gene complexes may be introduced randomly or by homologous recombination into mouse embryonic stem cells. Alternatively, the human variable region, constant region, and diversity region may be introduced into mouse embryonic stem cells in addition to the human heavy and light chain genes. The mouse heavy and light chain immunoglobulin genes may be rendered non-functional separately or simultaneously with the introduction of human immunoglobulin loci by homologous recombination. In particular, homozygous deletion of the JH region prevents endogenous antibody production. The modified embryonic stem cells are expanded and microinjected into blastocysts to produce chimeric mice. The chimeric mice are then be bred to produce homozygous offspring which express human antibodies. The transgenic mice are immunized in the normal fashion with a selected antigen, *e.g.*, all or a portion of a polypeptide of the invention. Monoclonal antibodies directed against the antigen can be obtained from the immunized, transgenic mice using conventional hybridoma technology. The human immunoglobulin transgenes harbored by the transgenic mice rearrange during B cell differentiation, and subsequently undergo class switching and somatic mutation. Thus, using such a technique, it is possible to produce therapeutically useful IgG, IgA, IgM and IgE antibodies. For an overview of this technology for producing human antibodies, see Lonberg and Huszar (1995, *Int. Rev. Immunol.* 13:65-93). For a detailed discussion of this technology for producing human antibodies and human monoclonal antibodies and protocols for producing such antibodies, *see, e.g.*, PCT publication Nos. WO 98/24893, WO 96/34096, and WO 96/33735; and U.S. Patent Nos. 5,413,923, 5,625,126, 5,633,425, 5,569,825, 5,661,016, 5,545,806, 5,814,318, and 5,939,598, which are incorporated by reference herein in their entireties. In addition, companies such as Medarex, Inc. (Princeton, NJ), Abgenix, Inc. (Freemont, CA) and Genpharm (San Jose, CA) can be engaged to provide human antibodies directed against a selected antigen using technology similar to that described above.

A chimeric antibody is a molecule in which different portions of the antibody are derived from different immunoglobulin molecules such as antibodies having a variable region derived from a non-human (*e.g.*, murine) antibody and a human immunoglobulin constant

region. Methods for producing chimeric antibodies are known in the art. See *e.g.*, Morrison, 1985, Science 229:1202; Oi et al., 1986, BioTechniques 4:214; Gillies et al., 1989, J. Immunol. Methods 125:191-202; and U.S. Patent Nos. 5,807,715, 4,816,567, and 4,816,397, which are incorporated herein by reference in their entireties. Chimeric antibodies comprising one or more CDRs from human species and framework regions from a non-human immunoglobulin molecule can be produced using a variety of techniques known in the art including, for example, CDR-grafting (EP 239,400; PCT publication No. WO 91/09967; and U.S. Patent Nos. 5,225,539, 5,530,101, and 5,585,089), veneering or resurfacing (EP 592,106; EP 519,596; Padlan, 1991, Molecular Immunology 28(4/5):489-498; Studnicka et al., 1994, Protein Engineering 7(6):805-814; and Roguska et al., 1994, PNAS 91:969-973), and chain shuffling (U.S. Patent No. 5,565,332). In a preferred embodiment, antibodies comprise one or more CDRs listed in Table 3 (preferably all CDRs) and human framework regions. Often, framework residues in the framework regions will be substituted with the corresponding residue from the CDR donor antibody to alter, preferably improve, antigen binding. These framework substitutions are identified by methods well known in the art, *e.g.*, by modeling of the interactions of the CDR and framework residues to identify framework residues important for antigen binding and sequence comparison to identify unusual framework residues at particular positions. (See, *e.g.*, Queen et al., U.S. Patent No. 5,585,089; and Riechmann et al., 1988, Nature 332:323, which are incorporated herein by reference in their entireties.)

Further, the antibodies to be used with the methods of the invention can, in turn, be utilized to generate anti-idiotypic antibodies that "mimic" RSV, PIV, and/or hMPV antigens using techniques well known to those skilled in the art. (See, *e.g.*, Greenspan & Bona, 1989, FASEB J. 7(5):437-444; and Nissinoff, 1991, J. Immunol. 147(8):2429-2438). For example, antibodies of the invention which bind to and competitively inhibit the binding of RSV, PIV, and/or hMPV (as determined by assays well known in the art) to its host cell receptor can be used to generate anti-idiotypes that "mimic" a RSV, PIV, and/or hMPV antigen and bind to the RSV, PIV, and/or hMPV receptors, *i.e.*, compete with the virus for binding to the host cell, therefore decreasing the infection rate of host cells with virus.

In certain other embodiments, anti-anti-idiotypes, generated by techniques well-known to the skilled artisan, are used in the methods of the invention. Such anti-anti-idiotypes mimic the binding domain of the anti-RSV, -PIV, and/or -hMPV antibody and, as a consequence, bind to and neutralize RSV, PIV, and/or hMPV. Such neutralizing anti-anti-

idiotypes or Fab fragments of such anti-anti-idiotypes can be used in therapeutic regimens to neutralize RSV, PIV, and/or hMPV. For example, such anti-anti-idiotypic antibodies can be used to bind RSV, PIV, and/or hMPV and thereby prevent infection.

In certain embodiments, a fragment of a protein of RSV, PIV, or hMPV is used as an immunogen for the generation of antibodies to be used with the methods of the invention. A fragment of a protein of RSV, PIV, or hMPV to be used as an immunogen can be at least 10, 20, 30, 40, 50, 75, 100, 250, 500, 750, or at least 1000 amino acids in length. In certain embodiments a synthetic peptide of a protein of RSV, PIV, or hMPV is used as an immunogen.

In certain embodiments, fragments of viral antigens are used as immunogen to produce antibodies to be used with the methods of the invention. In certain embodiments, fragments preferably contain a sequence of at least 4, at least 5, at least 6, at least 7, more preferably at least 8, at least 9, at least 10, at least 11, at least 12, at least 13, at least 14, at least 15, at least 20, at least 25, at least 30, at least 40, at least 50, at least 75 or at least 100 amino acids. In certain, more specific embodiments, a fragment is about 15 to about 30 amino acids long. Preferred polypeptides comprising immunogenic or antigenic epitopes are at least 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, or 100 amino acid residues in length. Additional non-exclusive preferred antigenic epitopes include the antigenic epitopes disclosed herein, as well as portions thereof.

4.1.2 POLYNUCLEOTIDES ENCODING AN ANTIBODY

Polynucleotides encoding antibodies to be used with the invention may be obtained, and the nucleotide sequence of the polynucleotides determined, by any method known in the art. Since amino acid sequences of some antibodies are known (as described in Table 2), nucleotide sequences encoding these antibodies can be determined using methods well known in the art, *i.e.*, nucleotide codons known to encode particular amino acids are assembled in such a way to generate a nucleic acid that encodes the antibody or fragment thereof of the invention. Such a polynucleotide encoding the antibody may be assembled from chemically synthesized oligonucleotides (*e.g.*, as described in Kutmeier et al., 1994, BioTechniques 17:242), which, briefly, involves the synthesis of overlapping oligonucleotides containing portions of the sequence encoding the antibody, annealing and ligating of those oligonucleotides, and then amplification of the ligated oligonucleotides by PCR.

Alternatively, a polynucleotide encoding an antibody may be generated from nucleic acid from a suitable source. If a clone containing a nucleic acid encoding a particular antibody is not available, but the sequence of the antibody molecule is known, a nucleic acid encoding the immunoglobulin may be chemically synthesized or obtained from a suitable source (*e.g.*, an antibody cDNA library, or a cDNA library generated from, or nucleic acid, preferably poly A⁺ RNA, isolated from, any tissue or cells expressing the antibody, such as hybridoma cells selected to express an antibody of the invention) by PCR amplification using synthetic primers hybridizable to the 3' and 5' ends of the sequence or by cloning using an oligonucleotide probe specific for the particular gene sequence to identify, *e.g.*, a cDNA clone from a cDNA library that encodes the antibody. Amplified nucleic acids generated by PCR may then be cloned into replicable cloning vectors using any method well known in the art.

Once the nucleotide sequence of the antibody is determined, the nucleotide sequence of the antibody may be manipulated using methods well known in the art for the manipulation of nucleotide sequences, *e.g.*, recombinant DNA techniques, site directed mutagenesis, PCR, etc. (see, for example, the techniques described in Sambrook et al., 1990, *Molecular Cloning, A Laboratory Manual*, 2d Ed., Cold Spring Harbor Laboratory, Cold Spring Harbor, NY and Ausubel *et al.*, eds., 1998, *Current Protocols in Molecular Biology*, John Wiley & Sons, NY, which are both incorporated by reference herein in their entireties), to generate antibodies having a different amino acid sequence, for example to create amino acid substitutions, deletions, and/or insertions.

In a specific embodiment, one or more of the CDRs is inserted within framework regions using routine recombinant DNA techniques. The framework regions may be naturally occurring or consensus framework regions, and preferably human framework regions (see, *e.g.*, Chothia et al., 1998, *J. Mol. Biol.* 278: 457-479 for a listing of human framework regions). Preferably, the polynucleotide generated by the combination of the framework regions and CDRs encodes an antibody that specifically binds to a RSV, PIV, and/or hMPV antigen. In certain embodiments, one or more amino acid substitutions may be made within the framework regions, and, preferably, the amino acid substitutions improve binding of the antibody to its antigen. Additionally, such methods may be used to make amino acid substitutions or deletions of one or more variable region cysteine residues participating in an intrachain disulfide bond to generate antibody molecules lacking one or

more intrachain disulfide bonds. Other alterations to the polynucleotide are encompassed by the present invention and within the skill of the art.

4.1.3 RECOMBINANT EXPRESSION OF AN ANTIBODY

Recombinant expression of an antibody to be used with the methods of the invention, derivative or analog thereof, (*e.g.*, a heavy or light chain of an antibody of the invention or a portion thereof or a single chain antibody of the invention), requires construction of an expression vector containing a polynucleotide that encodes the antibody. Once a polynucleotide encoding an antibody molecule or a heavy or light chain of an antibody, or portion thereof (preferably, but not necessarily, containing the heavy or light chain variable domain), of the invention has been obtained, the vector for the production of the antibody molecule may be produced by recombinant DNA technology using techniques well known in the art. Thus, methods for preparing a protein by expressing a polynucleotide containing an antibody encoding nucleotide sequence are described herein. Methods which are well known to those skilled in the art can be used to construct expression vectors containing antibody coding sequences and appropriate transcriptional and translational control signals. These methods include, for example, *in vitro* recombinant DNA techniques, synthetic techniques, and *in vivo* genetic recombination. The invention, thus, provides replicable vectors comprising a nucleotide sequence encoding an antibody molecule of the invention, a heavy or light chain of an antibody, a heavy or light chain variable domain of an antibody or a portion thereof, or a heavy or light chain CDR, operably linked to a promoter. Such vectors may include the nucleotide sequence encoding the constant region of the antibody molecule (see, *e.g.*, PCT Publication WO 86/05807; PCT Publication WO 89/01036; and U.S. Patent No. 5,122,464) and the variable domain of the antibody may be cloned into such a vector for expression of the entire heavy, the entire light chain, or both the entire heavy and light chains.

The expression vector is transferred to a host cell by conventional techniques and the transfected cells are then cultured by conventional techniques to produce an antibody of the invention. Thus, the invention includes host cells containing a polynucleotide encoding an antibody of the invention or fragments thereof, or a heavy or light chain thereof, or portion thereof, or a single chain antibody of the invention, operably linked to a heterologous promoter. In preferred embodiments for the expression of double-chained antibodies, vectors encoding both the heavy and light chains may be co-expressed in the host cell for expression of the entire immunoglobulin molecule, as detailed below.

A variety of host-expression vector systems may be utilized to express the antibody molecules of the invention (see, *e.g.*, U.S. Patent No. 5,807,715). Such host-expression systems represent vehicles by which the coding sequences of interest may be produced and subsequently purified, but also represent cells which may, when transformed or transfected with the appropriate nucleotide coding sequences, express an antibody molecule of the invention *in situ*. These include but are not limited to microorganisms such as bacteria (*e.g.*, *E. coli* and *B. subtilis*) transformed with recombinant bacteriophage DNA, plasmid DNA or cosmid DNA expression vectors containing antibody coding sequences; yeast (*e.g.*, *Saccharomyces Pichia*) transformed with recombinant yeast expression vectors containing antibody coding sequences; insect cell systems infected with recombinant virus expression vectors (*e.g.*, baculovirus) containing antibody coding sequences; plant cell systems infected with recombinant virus expression vectors (*e.g.*, cauliflower mosaic virus, CaMV; tobacco mosaic virus, TMV) or transformed with recombinant plasmid expression vectors (*e.g.*, Ti plasmid) containing antibody coding sequences; or mammalian cell systems (*e.g.*, COS, CHO, BHK, 293, NS0, and 3T3 cells) harboring recombinant expression constructs containing promoters derived from the genome of mammalian cells (*e.g.*, metallothionein promoter) or from mammalian viruses (*e.g.*, the adenovirus late promoter; the vaccinia virus 7.5K promoter). Preferably, bacterial cells such as *Escherichia coli*, and more preferably, eukaryotic cells, especially for the expression of whole recombinant antibody molecule, are used for the expression of a recombinant antibody molecule. For example, mammalian cells such as Chinese hamster ovary cells (CHO), in conjunction with a vector such as the major intermediate early gene promoter element from human cytomegalovirus is an effective expression system for antibodies (Foecking et al., 1986, Gene 45:101; and Cockett et al., 1990, Bio/Technology 8:2). In a specific embodiment, the expression of nucleotide sequences encoding antibodies or antigen-binding fragments thereof which immunospecifically bind to one or more RSV antigens is regulated by a constitutive promoter, inducible promoter or tissue specific promoter.

In bacterial systems, a number of expression vectors may be advantageously selected depending upon the use intended for the antibody molecule being expressed. For example, when a large quantity of such a protein is to be produced, for the generation of pharmaceutical compositions of an antibody molecule, vectors which direct the expression of high levels of fusion protein products that are readily purified may be desirable. Such vectors include, but are not limited to, the *E. coli* expression vector pUR278 (Ruther et al., 1983,

EMBO 12:1791), in which the antibody coding sequence may be ligated individually into the vector in frame with the lac Z coding region so that a fusion protein is produced; pIN vectors (Inouye & Inouye, 1985, Nucleic Acids Res. 13:3101-3109; Van Heeke & Schuster, 1989, J. Biol. Chem. 24:5503-5509); and the like. pGEX vectors may also be used to express foreign polypeptides as fusion proteins with glutathione S-transferase (GST). In general, such fusion proteins are soluble and can easily be purified from lysed cells by adsorption and binding to matrix glutathione agarose beads followed by elution in the presence of free glutathione. The pGEX vectors are designed to include thrombin or factor Xa protease cleavage sites so that the cloned target gene product can be released from the GST moiety.

In an insect system, *Autographa californica* nuclear polyhedrosis virus (AcNPV) is used as a vector to express foreign genes. The virus grows in *Spodoptera frugiperda* cells. The antibody coding sequence may be cloned individually into non-essential regions (for example, the polyhedrin gene) of the virus and placed under control of an AcNPV promoter (for example, the polyhedrin promoter).

In mammalian host cells, a number of viral-based expression systems may be utilized. In cases where an adenovirus is used as an expression vector, the antibody coding sequence of interest may be ligated to an adenovirus transcription/translation control complex, *e.g.*, the late promoter and tripartite leader sequence. This chimeric gene may then be inserted in the adenovirus genome by *in vitro* or *in vivo* recombination. Insertion in a non-essential region of the viral genome (*e.g.*, region E1 or E3) will result in a recombinant virus that is viable and capable of expressing the antibody molecule in infected hosts (*e.g.*, see Logan & Shenk, 1984, Proc. Natl. Acad. Sci. USA 81:355-359). Specific initiation signals may also be required for efficient translation of inserted antibody coding sequences. These signals include the ATG initiation codon and adjacent sequences. Furthermore, the initiation codon must be in phase with the reading frame of the desired coding sequence to ensure translation of the entire insert. These exogenous translational control signals and initiation codons can be of a variety of origins, both natural and synthetic. The efficiency of expression may be enhanced by the inclusion of appropriate transcription enhancer elements, transcription terminators, etc. (see, *e.g.*, Bittner et al., 1987, Methods in Enzymol. 153:516-544).

In addition, a host cell strain may be chosen which modulates the expression of the inserted sequences, or modifies and processes the gene product in the specific fashion desired. Such modifications (*e.g.*, glycosylation) and processing (*e.g.*, cleavage) of protein products may be important for the function of the protein. Different host cells have

characteristic and specific mechanisms for the post-translational processing and modification of proteins and gene products. Appropriate cell lines or host systems can be chosen to ensure the correct modification and processing of the foreign protein expressed. To this end, eukaryotic host cells which possess the cellular machinery for proper processing of the primary transcript, glycosylation, and phosphorylation of the gene product may be used. Such mammalian host cells include but are not limited to CHO, VERY, BHK, Hela, COS, MDCK, 293, 3T3, W138, BT483, Hs578T, HTB2, BT2O and T47D, NS0 (a murine myeloma cell line that does not endogenously produce any immunoglobulin chains), CRL703O and HsS78Bst cells.

For long-term, high-yield production of recombinant proteins, stable expression is preferred. For example, cell lines which stably express the antibody molecule may be engineered. Rather than using expression vectors which contain viral origins of replication, host cells can be transformed with DNA controlled by appropriate expression control elements (*e.g.*, promoter, enhancer, sequences, transcription terminators, polyadenylation sites, etc.), and a selectable marker. Following the introduction of the foreign DNA, engineered cells may be allowed to grow for 1-2 days in an enriched media, and then are switched to a selective media. The selectable marker in the recombinant plasmid confers resistance to the selection and allows cells to stably integrate the plasmid into their chromosomes and grow to form foci which in turn can be cloned and expanded into cell lines. This method may advantageously be used to engineer cell lines which express the antibody molecule. Such engineered cell lines may be particularly useful in screening and evaluation of compositions that interact directly or indirectly with the antibody molecule.

A number of selection systems may be used, including but not limited to, the herpes simplex virus thymidine kinase (Wigler et al., 1977, Cell 11:223), hypoxanthineguanine phosphoribosyltransferase (Szybalska & Szybalski, 1992, Proc. Natl. Acad. Sci. USA 48:202), and adenine phosphoribosyltransferase (Lowy et al., 1980, Cell 22:8-17) genes can be employed in tk-, hgp^rt- or ap^rt- cells, respectively. Also, antimetabolite resistance can be used as the basis of selection for the following genes: *dhfr*, which confers resistance to methotrexate (Wigler et al., 1980, Natl. Acad. Sci. USA 77:357; O'Hare et al., 1981, Proc. Natl. Acad. Sci. USA 78:1527); *gpt*, which confers resistance to mycophenolic acid (Mulligan & Berg, 1981, Proc. Natl. Acad. Sci. USA 78:2072); neo, which confers resistance to the aminoglycoside G-418 (Wu and Wu, 1991, Biotherapy 3:87-95; Tolstoshev, 1993, Ann. Rev. Pharmacol. Toxicol. 32:573-596; Mulligan, 1993, Science 260:926-932; and

Morgan and Anderson, 1993, *Ann. Rev. Biochem.* 62: 191-217; May, 1993, *TIB TECH* 11(5):155-215; and *hygro*, which confers resistance to hygromycin (Santerre et al., 1984, *Gene* 30:147). Methods commonly known in the art of recombinant DNA technology may be routinely applied to select the desired recombinant clone, and such methods are described, for example, in Ausubel *et al.* (eds.), *Current Protocols in Molecular Biology*, John Wiley & Sons, NY (1993); Kriegler, *Gene Transfer and Expression, A Laboratory Manual*, Stockton Press, NY (1990); and in Chapters 12 and 13, Dracopoli *et al.* (eds), *Current Protocols in Human Genetics*, John Wiley & Sons, NY (1994); Colberre-Garapin et al., 1981, *J. Mol. Biol.* 150:1, which are incorporated by reference herein in their entireties.

The expression levels of an antibody molecule can be increased by vector amplification (for a review, see Bebbington and Hentschel, *The use of vectors based on gene amplification for the expression of cloned genes in mammalian cells in DNA cloning*, Vol.3. (Academic Press, New York, 1987)). When a marker in the vector system expressing antibody is amplifiable, increase in the level of inhibitor present in culture of host cell will increase the number of copies of the marker gene. Since the amplified region is associated with the antibody gene, production of the antibody will also increase (Crouse et al., 1983, *Mol. Cell. Biol.* 3:257).

The host cell may be co-transfected with two expression vectors of the invention, the first vector encoding a heavy chain derived polypeptide and the second vector encoding a light chain derived polypeptide. The two vectors may contain identical selectable markers which enable equal expression of heavy and light chain polypeptides. Alternatively, a single vector may be used which encodes, and is capable of expressing, both heavy and light chain polypeptides. In such situations, the light chain should be placed before the heavy chain to avoid an excess of toxic free heavy chain (Proudfoot, 1986, *Nature* 322:52; and Kohler, 1980, *Proc. Natl. Acad. Sci. USA* 77:2197). The coding sequences for the heavy and light chains may comprise cDNA or genomic DNA.

Once an antibody molecule to be used with the methods of the invention has been produced by recombinant expression, it may be purified by any method known in the art for purification of an immunoglobulin molecule, for example, by chromatography (*e.g.*, ion exchange, affinity, particularly by affinity for the specific antigen after Protein A, and sizing column chromatography), centrifugation, differential solubility, or by any other standard technique for the purification of proteins. Further, the antibodies of the present invention or

fragments thereof may be fused to heterologous polypeptide sequences described herein or otherwise known in the art to facilitate purification.

4.1.4 BiTE TECHNOLOGY

In certain embodiments, antibodies to be used with the methods of the invention and antibodies of the pharmaceutical compositions of the invention are bispecific T cell engagers (BiTEs). Bispecific T cell engagers (BiTE) are bispecific antibodies that can redirect T cells for antigen-specific elimination of targets. A BiTE molecule has an antigen-binding domain that binds to a T cell antigen (*e.g.* CD3) at one end of the molecule and an antigen binding domain that will bind to an antigen on the target cell. A BiTE molecule was recently described in WO 99/54440, which is herein incorporated by reference. This publication describes a novel single-chain multifunctional polypeptide that comprises binding sites for the CD19 and CD3 antigens (CD19xCD3). This molecule was derived from two antibodies, one that binds to CD19 on the B cell and an antibody that binds to CD3 on the T cells. The variable regions of these different antibodies are linked by a polypeptide sequence, thus creating a single molecule. Also described, is the linking of the variable heavy chain (VH) and light chain (VL) of a specific binding domain with a flexible linker to create a single chain, bispecific antibody.

In an embodiment of this invention, an antibody or a fragment thereof that immunospecifically binds a polypeptide of interest (*e.g.*, an antigen of MPV, RSV and/or PIV) will comprise a portion of the BiTE molecule. For example, the VH and/or VL (preferably a scFV) of an antibody that binds a polypeptide of interest (*e.g.*, an antigen of MPV, RSV and/or PIV) can be fused to an anti-CD3 binding portion such as that of the molecule described above, thus creating a BiTE molecule that targets the polypeptide of interest (*e.g.*, an antigen of MPV, RSV and/or PIV). In addition to the variable heavy and or light chain of antibody against a polypeptide of interest (*e.g.*, an antigen of MPV, RSV and/or PIV), other molecules that bind the polypeptide of interest (*e.g.*, an antigen of MPV, RSV and/or PIV) can comprise the BiTE molecule, for example antiviral compounds. In another embodiment, the BiTE molecule can comprise a molecule that binds to other T cell antigens (other than CD3). For example, ligands and/or antibodies that immunospecifically bind to T-cell antigens like CD2, CD4, CD8, CD11a, TCR, and CD28 are contemplated to be part of this invention. This list is not meant to be exhaustive but only to illustrate that other molecules that can immunospecifically bind to a T cell antigen can be used as part of a BiTE

molecule. These molecules can include the VH and/or VL portions of the antibody or natural ligands (for example LFA3 whose natural ligand is CD3). A BiTE molecule can be an antagonist.

The “binding domain” as used in accordance with the present invention denotes a domain comprising a three-dimensional structure capable of specifically binding to an epitope like native antibodies, free scFv fragments or one of their corresponding immunoglobulin chains, preferably the VH chain. Thus, said domain can comprise the VH and/or VL domain of an antibody or an immunoglobulin chain, preferably at least the VH domain or more preferably the VH and VL domain linked by a flexible polypeptide linker (scFv). On the other hand, said binding domain contained in the polypeptide of interest may comprise at least one complementarity determining region (CDR) of an antibody or immunoglobulin chain recognizing an antigen on the T cell or a cellular antigen. In this respect, it is noted that the binding domain present in the polypeptide of interest may not only be derived from antibodies but also from other T cell or cellular antigen binding protein, such as naturally occurring surface receptors or ligands. It is further contemplated that in an embodiment of the invention, said first and or second domain of the above-described polypeptide mimic or correspond to a VH and VL region from a natural antibody. The antibody providing the binding site for the polypeptide of interest can be, *e.g.*, a monoclonal antibody, polyclonal antibody, chimeric antibody, humanized antibody, bispecific antibody, synthetic antibody, antibody fragment, such as Fab, Fv or scFv fragments etc., or a chemically modified derivative of any of these.

4.1.5 ANTIBODY CONJUGATES

In certain embodiments, the antibodies to be used with the methods of the invention or fragments thereof are recombinantly fused or chemically conjugated (including both covalently and non-covalently conjugations) to a heterologous polypeptide (or portion thereof, preferably at least 10, at least 20, at least 30, at least 40, at least 50, at least 60, at least 70, at least 80, at least 90 or at least 100 amino acids of the polypeptide) to generate fusion proteins. The fusion does not necessarily need to be direct, but may occur through linker sequences. For example, antibodies may be used to target heterologous polypeptides to particular cell types (*e.g.*, respiratory epithelial cells), either *in vitro* or *in vivo*, by fusing or conjugating the antibodies to antibodies specific for particular cell surface receptors. Antibodies fused or conjugated to heterologous polypeptides may also be used in *in vitro*

immunoassays and purification methods using methods known in the art. See *e.g.*, PCT publication WO 93/21232; EP 439,095; Naramura *et al.*, Immunol. Lett. 39:91-99 (1994); U.S. Patent 5,474,981; Gillies *et al.*, PNAS 89:1428-1432 (1992); and Fell *et al.*, J. Immunol. 146:2446-2452(1991), which are incorporated by reference in their entireties.

In certain embodiments, the anti-RSV-antigen antibody is an antibody conjugate. In other embodiments, the anti-PIV-antigen antibody is an antibody conjugate. In other embodiments, the anti-hMPV-antigen antibody is an antibody conjugate.

Additional fusion proteins of the antibodies to be used with the methods of the invention or fragments thereof may be generated through the techniques of gene-shuffling, motif-shuffling, exon-shuffling, and/or codon-shuffling (collectively referred to as "DNA shuffling"). DNA shuffling may be employed to alter the activities of antibodies of the invention or fragments thereof (*e.g.*, antibodies or antigen-binding fragments thereof with higher affinities and lower dissociation rates). See, generally, U.S. Patent Nos. 5,605,793; 5,811,238; 5,830,721; 5,834,252; and 5,837,458, and Patten *et al.*, Curr. Opinion Biotechnol. 8:724-33 (1997); Harayama, Trends Biotechnol. 16(2):76-82 (1998); Hansson, *et al.*, J. Mol. Biol. 287:265-76 (1999); and Lorenzo and Blasco, Biotechniques 24(2):308- 13 (1998) (each of these patents and publications are hereby incorporated by reference in its entirety). In one embodiment, antibodies or antigen-binding fragments thereof, or the encoded antibodies or antigen-binding fragments thereof, may be altered by being subjected to random mutagenesis by error-prone PCR, random nucleotide insertion or other methods prior to recombination. In another embodiment, one or more portions of a polynucleotide encoding an antibody or antibody fragment, which portions immunospecifically bind to a RSV, PIV, and/or hMPV antigen may be recombined with one or more components, motifs, sections, parts, domains, fragments, etc. of one or more heterologous molecules.

Moreover, the antibodies to be used with the methods of the present invention or fragments thereof can be fused to marker sequences, such as a peptide to facilitate purification. In preferred embodiments, the marker amino acid sequence is a hexa-histidine peptide, such as the tag provided in a pQE vector (QIAGEN, Inc., 9259 Eton Avenue, Chatsworth, CA, 91311), among others, many of which are commercially available. As described in Gentz *et al.*, 1989, Proc. Natl. Acad. Sci. USA 86:821-824, for instance, hexa-histidine provides for convenient purification of the fusion protein. Other peptide tags useful for purification include, but are not limited to, the hemagglutinin"HA" tag, which

corresponds to an epitope derived from the influenza hemagglutinin protein (Wilson et al., 1984, Cell 37:767) and the "flag" tag.

An antibody or fragment thereof may be conjugated to a therapeutic moiety such as, but not limited to, a cytotoxin, *e.g.*, a cytostatic or cytocidal agent, a therapeutic agent or a radioactive metal ion, *e.g.*, alpha-emitters. A cytotoxin or cytotoxic agent includes, but is not limited to, any agent that is detrimental to cells. Examples include, but are not limited to, paclitaxol, cytochalasin B, gramicidin D, ethidium bromide, emetine, mitomycin, etoposide, tenoposide, vincristine, vinblastine, colchicin, doxorubicin, daunorubicin, dihydroxy anthracin dione, mitoxantrone, mithramycin, actinomycin D, 1-dehydrotestosterone, glucocorticoids, procaine, tetracaine, lidocaine, propranolol, and puromycin and analogs or homologs thereof. Therapeutic agents include, but are not limited to, antimetabolites (*e.g.*, methotrexate, 6-mercaptopurine, 6-thioguanine, cytarabine, 5-fluorouracil decarbazine), alkylating agents (*e.g.*, mechlorethamine, thioepa chlorambucil, melphalan, carmustine (BSNU) and lomustine (CCNU), cyclophosphamide, busulfan, dibromomannitol, streptozotocin, mitomycin C, and cis-dichlorodiamine platinum (II) (DDP) cisplatin), anthracyclines (*e.g.*, daunorubicin (formerly daunomycin) and doxorubicin), antibiotics (*e.g.*, dactinomycin (formerly actinomycin), bleomycin, mithramycin, and anthramycin (AMC)), anti-mitotic agents (*e.g.*, vincristine and vinblastine), and antivirals, such as, but not limited to: nucleoside analogs, such as zidovudine, acyclovir, gangcyclovir, vidarabine, idoxuridine, trifluridine, and ribavirin, as well as foscarnet, amantadine, rimantadine, saquinavir, indinavir, ritonavir, and the alpha-interferons.

Further, an antibody to be used with the methods of the invention or fragment thereof may be conjugated to a therapeutic agent or drug moiety that modifies a given biological response. Therapeutic agents or drug moieties are not to be construed as limited to classical chemical therapeutic agents. For example, the drug moiety may be a protein or polypeptide possessing a desired biological activity. Such proteins may include, but are not limited to, a toxin such as abrin, ricin A, pseudomonas exotoxin, or diphtheria toxin; a protein such as tumor necrosis factor, α -interferon, β -interferon, nerve growth factor, platelet derived growth factor, tissue plasminogen activator, an apoptotic agent, *e.g.*, TNF- α , TNF- β , AIM I (see, International Publication No. WO 97/33899), AIM II (see, International Publication No. WO 97/34911), Fas Ligand (Takahashi et al., 1994, J. Immunol., 6:1567-1574), and VEGI (see, International Publication No. WO 99/23105), a thrombotic agent or an anti-angiogenic agent, *e.g.*, angiostatin or endostatin; or, a biological response modifier such as, for example, a

lymphokine (*e.g.*, interleukin-1 (“IL- 1”), interleukin-2 (“IL-2”), interleukin-6 (“IL-6”), granulocyte macrophage colony stimulating factor (“GM-CSF”), and granulocyte colony stimulating factor (“G-CSF”)), or a growth factor (*e.g.*, growth hormone (“GH”)).

Techniques for conjugating such therapeutic moieties to antibodies are well known, see, *e.g.*, Arnon *et al.*, “Monoclonal Antibodies For Immunotargeting Of Drugs In Cancer Therapy”, in *Monoclonal Antibodies And Cancer Therapy*, Reisfeld *et al.* (eds.), pp. 243-56 (Alan R. Liss, Inc. 1985); Hellstrom *et al.*, “Antibodies For Drug Delivery”, in *Controlled Drug Delivery* (2nd Ed.), Robinson *et al.* (eds.), pp. 623-53 (Marcel Dekker, Inc. 1987); Thorpe, “Antibody Carriers Of Cytotoxic Agents In Cancer Therapy: A Review”, in *Monoclonal Antibodies ‘84: Biological And Clinical Applications*, Pinchera *et al.* (eds.), pp. 475-506 (1985); “Analysis, Results, And Future Prospective Of The Therapeutic Use Of Radiolabeled Antibody In Cancer Therapy”, in *Monoclonal Antibodies For Cancer Detection And Therapy*, Baldwin *et al.* (eds.), pp. 303-16 (Academic Press 1985), and Thorpe *et al.*, 1982, *Immunol. Rev.* 62:119-58.

An antibody or fragment thereof, with or without a therapeutic moiety conjugated to it, administered alone or in combination with cytotoxic factor(s) and/or cytokine(s) can be used as a therapeutic.

Alternatively, an antibody can be conjugated to a second antibody to form an antibody heteroconjugate as described by Segal in U.S. Patent No. 4,676,980, which is incorporated herein by reference in its entirety.

Antibodies may also be attached to solid supports, which are particularly useful for immunoassays or purification of the target antigen. Such solid supports include, but are not limited to, glass, cellulose, polyacrylamide, nylon, polystyrene, polyvinyl chloride or polypropylene.

4.1.6 ANTI-RSV-ANTIGEN ANTIBODIES

Anti-RSV-antigen antibodies that can be used with the methods of the invention bind immunospecifically to an antigen of RSV. In certain embodiments, the anti-RSV-antigen antibody binds immunospecifically to an RSV antigen of the Group A of RSV. In certain embodiments, the anti-RSV-antigen antibody binds immunospecifically to an RSV antigen of the Group B of RSV. In certain embodiments, an antibody binds to an antigen of RSV of one Group and cross reacts with the analogous antigen of the other Group.

In certain embodiments, an anti-RSV-antigen antibody binds immunospecifically to a RSV nucleoprotein, RSV phosphoprotein, RSV matrix protein, RSV small hydrophobic protein, RSV RNA-dependent RNA polymerase, RSV F protein, and/or RSV G protein.

In certain embodiments, an anti-RSV-antigen antibody binds to allelic variants of a RSV nucleoprotein, a RSV phosphoprotein, a RSV matrix protein, a RSV small hydrophobic protein, a RSV RNA-dependent RNA polymerase, a RSV F protein, and/or a RSV G protein.

In certain embodiments, the anti-RSV-antigen antibody binds immunospecifically to, *inter alia*, an RSV attachment glycoprotein, *e.g.*, having an amino acid sequence of SEQ ID NO:390; a RSV fusion glycoprotein, *e.g.*, having an amino acid sequence of SEQ ID NO:391; a RSV small hydrophobic protein, *e.g.*, having an amino acid sequence of SEQ ID NO:392; a RSV RNA polymerase beta subunit (Large structural protein) (L protein), *e.g.*, having an amino acid sequence of SEQ ID NO:393; a RSV phosphoprotein P, *e.g.*, having an amino acid sequence of SEQ ID NO:394; an RSV attachment glycoprotein G, *e.g.*, having an amino acid sequence of SEQ ID NO:395; a RSV nucleocapsid protein, *e.g.*, having an amino acid sequence of SEQ ID NO:396; a RSV nucleoprotein (N), *e.g.*, having an amino acid sequence of SEQ ID NO:397; and/or a RSV matrix protein, *e.g.*, having an amino acid sequence of SEQ ID NO:398.

In certain embodiments, the anti-RSV-antigen antibody binds immunospecifically to a protein/polypeptide that consists of an amino acid sequence that is at least 60%, 70%, 80%, 90%, 95%, or at least 98% identical to the amino acid sequence of the attachment glycoprotein of SEQ ID NO:390; the fusion glycoprotein of SEQ ID NO:391; the small hydrophobic protein of SEQ ID NO:392; the RNA polymerase beta subunit (Large structural protein) (L protein) of SEQ ID NO:393; the phosphoprotein P of SEQ ID NO:394; the attachment glycoprotein G of SEQ ID NO:395; the nucleocapsid protein of SEQ ID NO:396; the nucleoprotein (N) of SEQ ID NO:397; and/or the matrix protein of SEQ ID NO:398. In certain embodiments, the anti-RSV-antigen antibody binds immunospecifically to a protein/polypeptide that consists of an amino acid sequence that is at most 70%, 80%, 90%, 95%, 98% or at most 100% identical to the amino acid sequence of the attachment glycoprotein of SEQ ID NO:390; the fusion glycoprotein of SEQ ID NO:391; the small hydrophobic protein of SEQ ID NO:392; the RNA polymerase beta subunit (Large structural protein) (L protein) of SEQ ID NO:393; the phosphoprotein P of SEQ ID NO:394; the attachment glycoprotein G of SEQ ID NO:395; the nucleocapsid protein of SEQ ID NO:396; the nucleoprotein (N) of SEQ ID NO:397; and/or the matrix protein of SEQ ID NO:398.

In certain embodiments, the anti-RSV-antigen antibodies are the anti-RSV-antigen antibodies of or are prepared by the methods of U.S. Application No: 09/724,531, filed November 28, 2000; 09/996,288, filed November 28, 2001; and 09/996,265, filed November 28, 2001, all entitled "Methods of Administering/Dosing Anti-RSV Antibodies for Prophylaxis and Treatment", by Young et al., which are incorporated by reference herein in their entireties. Methods and composition for stabilized antibody formulations that can be used in the methods of the present invention are disclosed in U.S. Provisional Application Nos.: 60/388,921, filed June 14, 2002, and 60/388,920, filed June 14, 2002, which are incorporated by reference herein in their entireties.

In certain embodiments, the one or more antibodies or antigen-binding fragments thereof that bind immunospecifically to a RSV antigen comprise a Fc domain with a higher affinity for the FcRn receptor than the Fc domain of SYNAGIS® (Palivizumab). Such antibodies are described in U.S. Patent Application No.: 10/020,354, filed December 12, 2001, which is incorporated herein by reference in its entireties.

In certain embodiments, the one or more anti-RSV-antigen antibodies include, but are not limited to, SYNAGIS® (Palivizumab). In certain embodiments, the one or more anti-RSV-antigen antibodies include, but are not limited to, A4B4 (see section 4.1.5). In certain specific embodiments, the anti-RSV-antigen antibody is AFFF; P12f2 P12f4; P11d4; Ale9; A12a6; A13c4; A17d4; A4B4; 1X-493L1; FR H3-3F4; M3H9; Y10H6; DG; AFFF(1); 6H8; L1-7E5; L2-15B10; A13a11; A1h5; A4B4(1); A4B4-F52S; or A4B4L1FR-S28R. These antibodies are disclosed in International Application Publication No.: WO 02/43660, entitled "Methods of Administering/Dosing Anti-RSV Antibodies for Prophylaxis and Treatment", by Young et al., which is incorporated herein by reference in its entirety.

In certain embodiments, the one or more antibodies that bind to a RSV antigen has a higher avidity and/or affinity for a RSV antigen than SYNAGIS® has for the RSV F glycoprotein. In certain embodiments, the one or more antibodies that bind immunospecifically to a RSV antigen has a higher affinity and/or avidity for a RSV antigen than any previously known anti-RSV-antigen specific antibodies or antigen-binding fragments thereof. In certain embodiments, anti-RSV-antigen antibody is not SYNAGIS®.

For the methods of the present invention, antibodies or antigen-binding fragments thereof which immunospecifically bind to a RSV antigen with an affinity constant of at least $2 \times 10^8 \text{ M}^{-1}$, at least $2.5 \times 10^8 \text{ M}^{-1}$, at least $5 \times 10^8 \text{ M}^{-1}$, at least 10^9 M^{-1} , at least $5 \times 10^9 \text{ M}^{-1}$, at least 10^{10} M^{-1} , at least $5 \times 10^{10} \text{ M}^{-1}$, at least 10^{11} M^{-1} , at least $5 \times 10^{11} \text{ M}^{-1}$, at least 10^{12} M^{-1}

¹, at least $5 \times 10^{12} \text{ M}^{-1}$, at least 10^{13} M^{-1} , at least $5 \times 10^{13} \text{ M}^{-1}$, at least 10^{14} M^{-1} , at least $5 \times 10^{14} \text{ M}^{-1}$, at least 10^{15} M^{-1} , or at least $5 \times 10^{15} \text{ M}^{-1}$ can be used. In a specific embodiment, the antibody that binds immunospecifically to a RSV antigen is SYNAGIS®, which binds to the RSV F glycoprotein. The present invention also provides pharmaceutical compositions comprising (i) one or more antibodies which immunospecifically bind to a RSV antigen with an affinity constant of at least $2 \times 10^8 \text{ M}^{-1}$, at least $2.5 \times 10^8 \text{ M}^{-1}$, at least $5 \times 10^8 \text{ M}^{-1}$, at least 10^9 M^{-1} , at least $5 \times 10^9 \text{ M}^{-1}$, at least 10^{10} M^{-1} , at least $5 \times 10^{10} \text{ M}^{-1}$, at least 10^{11} M^{-1} , at least $5 \times 10^{11} \text{ M}^{-1}$, at least 10^{12} M^{-1} , at least $5 \times 10^{12} \text{ M}^{-1}$, at least 10^{13} M^{-1} , at least $5 \times 10^{13} \text{ M}^{-1}$, at least 10^{14} M^{-1} , at least $5 \times 10^{14} \text{ M}^{-1}$, at least 10^{15} M^{-1} , or at least $5 \times 10^{15} \text{ M}^{-1}$ and (ii) one or more antibodies which immunospecifically bind to a RSV antigen with an affinity constant of at least $2 \times 10^8 \text{ M}^{-1}$, at least $2.5 \times 10^8 \text{ M}^{-1}$, at least $5 \times 10^8 \text{ M}^{-1}$, at least 10^9 M^{-1} , at least $5 \times 10^9 \text{ M}^{-1}$, at least 10^{10} M^{-1} , at least $5 \times 10^{10} \text{ M}^{-1}$, at least 10^{11} M^{-1} , at least $5 \times 10^{11} \text{ M}^{-1}$, at least 10^{12} M^{-1} , at least $5 \times 10^{12} \text{ M}^{-1}$, at least 10^{13} M^{-1} , at least $5 \times 10^{13} \text{ M}^{-1}$, at least 10^{14} M^{-1} , at least $5 \times 10^{14} \text{ M}^{-1}$, at least 10^{15} M^{-1} , or at least $5 \times 10^{15} \text{ M}^{-1}$.

It should be recognized that antibodies that immunospecifically bind to a RSV antigen are known in the art. For example, SYNAGIS® is a humanized monoclonal antibody presently used for the prevention of RSV infection in pediatric patients. In a specific embodiment, an antibody to be used with the methods of the present invention is SYNAGIS® or an antibody-binding fragment thereof (*e.g.*, contains one or more complementarity determining regions (CDRs) and preferably, the variable domain of SYNAGIS®). The amino acid sequence of SYNAGIS® is disclosed, *e.g.*, in Johnson et al., 1997, J. Infectious Disease 176:1215-1224, and U.S. Patent No. 5,824,307 and International Application Publication No.: WO 02/43660, entitled "Methods of Administering/Dosing Anti-RSV Antibodies for Prophylaxis and Treatment", by Young et al., which are incorporated herein by reference in their entireties.

In certain embodiments, the antibodies to be used with the methods and compositions of the invention or fragments thereof bind immunospecifically to one or more RSV antigens regardless of the strain of RSV. In particular, the anti-RSV-antigen antibodies bind to an antigen of human RSV A and human RSV B. In certain embodiments, the anti-RSV-antigen antibodies bind to RSV antigens from one strain of RSV versus another RSV strain. In particular, the anti-RSV-antigen antibody binds to an antigen of human RSV A and not to human RSV B or vice versa. In a specific embodiment, the antibodies or antigen-binding fragments thereof immunospecifically bind to the RSV F glycoprotein, G glycoprotein or SH

protein. In certain embodiments, the anti-RSV-antigen antibodies bind immunospecifically to the RSV F glycoprotein. In another preferred embodiment, the anti-RSV-antigen antibodies or antigen-binding fragments thereof bind to the A, B, C, I, II, IV, V, or VI antigenic sites of the RSV F glycoprotein (see, *e.g.*, López et al., 1998, J. Virol. 72:6922-6928, which is incorporated herein by reference in its entirety). In certain embodiments, the anti-RSV-antigen antibodies bind to a RSV nucleoprotein, a RSV phosphoprotein, a RSV matrix protein, a RSV small hydrophobic protein, a RSV RNA-dependent RNA polymerase, a RSV F protein, or a RSV G protein.

In certain embodiments, the anti-RSV-antigen antibodies or antigen-binding fragments thereof have a high binding affinity for one or more RSV antigens. In a specific embodiment, an anti-RSV antibody or an antigen-binding fragment thereof has an association rate constant or k_{on} rate (antibody (Ab) + antigen (Ag) $\xrightarrow{k_{on}}$ Ab-Ag) of at least $10^5 \text{ M}^{-1}\text{s}^{-1}$, at least $5 \times 10^5 \text{ M}^{-1}\text{s}^{-1}$, at least $10^6 \text{ M}^{-1}\text{s}^{-1}$, at least $5 \times 10^6 \text{ M}^{-1}\text{s}^{-1}$, at least $10^7 \text{ M}^{-1}\text{s}^{-1}$, at least $5 \times 10^7 \text{ M}^{-1}\text{s}^{-1}$, or at least $10^8 \text{ M}^{-1}\text{s}^{-1}$. In a preferred embodiment, an antibody of the present invention or fragment thereof has a k_{on} of at least $2 \times 10^5 \text{ M}^{-1}\text{s}^{-1}$, at least $5 \times 10^5 \text{ M}^{-1}\text{s}^{-1}$, at least $10^6 \text{ M}^{-1}\text{s}^{-1}$, at least $5 \times 10^6 \text{ M}^{-1}\text{s}^{-1}$, at least $10^7 \text{ M}^{-1}\text{s}^{-1}$, at least $5 \times 10^7 \text{ M}^{-1}\text{s}^{-1}$, or at least $10^8 \text{ M}^{-1}\text{s}^{-1}$.

In another embodiment, anti-RSV-antigen antibodies or fragment thereof has a k_{off} rate (antibody (Ab) + antigen) of less than 10^{-1} s^{-1} , less than $5 \times 10^{-1} \text{ s}^{-1}$, less than 10^{-2} s^{-1} , less than $5 \times 10^{-2} \text{ s}^{-1}$, less than 10^{-3} s^{-1} , less than $5 \times 10^{-3} \text{ s}^{-1}$, less than 10^{-4} s^{-1} , less than $5 \times 10^{-4} \text{ s}^{-1}$, less than 10^{-5} s^{-1} , less than $5 \times 10^{-5} \text{ s}^{-1}$, less than 10^{-6} s^{-1} , less than $5 \times 10^{-6} \text{ s}^{-1}$, less than 10^{-7} s^{-1} , less than $5 \times 10^{-7} \text{ s}^{-1}$, less than 10^{-8} s^{-1} , less than $5 \times 10^{-8} \text{ s}^{-1}$, less than 10^{-9} s^{-1} , less than $5 \times 10^{-9} \text{ s}^{-1}$, or less than 10^{-10} s^{-1} . In a preferred embodiment, an anti-RSV-antigen antibodies or fragment thereof has a k_{on} of less than $5 \times 10^{-4} \text{ s}^{-1}$, less than 10^{-5} s^{-1} , less than $5 \times 10^{-5} \text{ s}^{-1}$, less than 10^{-6} s^{-1} , less than $5 \times 10^{-6} \text{ s}^{-1}$, less than 10^{-7} s^{-1} , less than $5 \times 10^{-7} \text{ s}^{-1}$, less than 10^{-8} s^{-1} , less than $5 \times 10^{-8} \text{ s}^{-1}$, less than 10^{-9} s^{-1} , or less than 10^{-10} s^{-1} .

In certain embodiments, the antibodies to be used with the methods of the invention or fragments thereof comprise the amino acid sequence of SYNAGIS® with one or more amino acid residue substitutions in one or more VL CDRs and/or one or more VH CDRs. In a specific embodiment, an antibody to be used with the methods of the invention comprises the amino acid sequence of SYNAGIS® with one or more amino acid residue substitutions of the amino acid residues indicated in bold face and underlining in Table 3. In accordance with this embodiment, the amino acid residue substitutions can be conservative or non-

conservative. The antibody or antibody fragment generated by introducing substitutions in the VH domain, VH CDRs, VL domain and/or VL CDRs of SYNAGIS® can be tested *in vitro* and *in vivo*, for example, for its ability to bind to RSV F antigen, for its ability to neutralize RSV, or for its ability to prevent, treat or ameliorate one or more symptoms associated with a RSV infection.

TABLE 3. CDR Sequences Of SYNAGIS®

CDR	Sequence
VH1	T <u>S</u> GMSVG
VH2	DIWWDD <u>DKKD</u> YNPSLK <u>S</u>
VH3	<u>S</u> MITN <u>W</u> YFDV
VL1	<u>KCQLS</u> VG Y MH
VL2	DTS <u>KL</u> AS
VL3	FQGS <u>G</u> YP <u>F</u> T

Bold faced & underlined amino acid residues are preferred residues which should be substituted.

In certain specific embodiments, the amino acid sequences of the different domains of one or more anti-RSV-antigen antibodies are as follows: **VH Domain:** SEQ ID NO:422; **VH CDR1:** TAGMSVG; **VH CDR2:** DIWWDDKKHYNPSLKD; **VH CDR3:** DMIFNFYFDV; **VL Domain:** SEQ ID NO:423; **VL CDR1:** SASSRVG~~Y~~MH; **VL CDR2:** DTLLLDS; **VL CDR3:** FQGSGYPFT. This antibody has been disclosed as A4B4(1) in International Application Publication No.: WO 02/43660, entitled “Methods of Administering/Dosing Anti-RSV Antibodies for Prophylaxis and Treatment”, by Young et al., which is incorporated by reference herein in its entirety.

In certain specific embodiments, the anti-RSV-antigen antibody is AFFF; P12f2 P12f4; P11d4; Ale9; A12a6; A13c4; A17d4; A4B4; 1X-493L1; FR H3-3F4; M3H9; Y10H6; DG; AFFF(1); 6H8; L1-7E5; L2-15B10; A13a11; A1h5; A4B4(1); A4B4-F52S; or A4B4L1FR-S28R. These antibodies are disclosed in International Application Publication No.: WO 02/43660, entitled “Methods of Administering/Dosing Anti-RSV Antibodies for Prophylaxis and Treatment”, by Young et al., which is incorporated herein by reference in its entirety.

4.1.7 ANTI-HMPV-ANTIGEN ANTIBODIES

Any antibody that immunospecifically binds to an hMPV or to a protein of hMPV or a fragment, an analog, a derivative or a homolog thereof can be used with the methods of the

invention. Mammalian MPV and proteins of mammalian MPV and homologs thereof are described in section 4.1.7.1.

4.1.7.1 hMPV

STRUCTURAL CHARACTERISTICS OF A MAMMALIAN METAPNEUMOVIRUS

A Mammalian MPV is a negative-sense single stranded RNA virus belonging to the sub-family *Pneumovirinae* of the family *Paramyxoviridae*. Moreover, the mammalian MPV is identifiable as phylogenetically corresponding to the genus *Metapneumovirus*, wherein the mammalian MPV is phylogenetically more closely related to a virus isolate deposited as I-2614 with CNCM, Paris (SEQ ID NO:19) than to turkey rhinotracheitis virus, the etiological agent of avian rhinotracheitis. A virus is identifiable as phylogenetically corresponding to the genus *Metapneumovirus* by, e.g., obtaining nucleic acid sequence information of the virus and testing it in phylogenetic analyses. Any technique known to the skilled artisan can be used to determine phylogenetic relationships between strains of viruses. Other techniques are disclosed in International Patent Application PCT/NL02/00040, published as WO 02/057302, which is incorporated by reference in its entirety herein. In particular, PCT/NL02/00040 discloses nucleic acid sequences that are suitable for phylogenetic analysis at page 12, line 27 to page 19, line 29, which are incorporated by reference herein. A virus can further be identified as a mammalian MPV on the basis of sequence similarity as described in more detail below.

In a specific embodiment, the mammalian MPV is a human MPV.

In addition to phylogenetic relatedness and sequence similarity of a virus to a mammalian MPV as disclosed herein, the similarity of the genomic organization of a virus to the genomic organization of a mammalian MPV disclosed herein can also be used to identify the virus as a mammalian MPV. In certain embodiments, the genomic organization of a mammalian MPV is different from the genomic organization of pneumoviruses within the sub-family *Pneumovirinae* of the family *Paramyxoviridae*. The classification of the two genera, metapneumovirus and pneumovirus, is based primarily on their gene constellation; metapneumoviruses generally lack non-structural proteins such as NS1 or NS2 (*see also* Randhawa *et al.*, 1997, J. Virol. 71:9849-9854) and the gene order is different from that of pneumoviruses (RSV: '3-NS1-NS2-N-P-M-SH-G-F-M2-L-5', APV:

'3-N-P-M-F-M2-SH-G-L-5') (Lung, *et al.*, 1992, J. Gen. Virol. 73:1709-17 15; Yu, *et al.*, 1992, *Virology* 186:426-434; Randhawa, *et al.*, 1997, J. Virol. 71:9849-9854).

Further, a mammalian MPV of the invention can be identified by its immunological properties. In certain embodiments, specific anti-sera can be raised against mammalian MPV that can neutralize mammalian MPV. Monoclonal and polyclonal antibodies can be raised against MPV that can also neutralize mammalian MPV. (See, WO 02/057302, which is incorporated by reference herein.

The mammalian MPV of the invention is further characterized by its ability to infect a mammalian host, *i.e.*, a mammalian cultured cell or a mammal. Unlike APV, mammalian MPV does not replicate or replicates only at low levels in chickens and turkeys. Mammalian MPV replicates, however, in mammalian hosts, such as cynomolgous macaques. In certain, more specific, embodiments, a mammalian MPV is further characterized by its ability to replicate in a mammalian host. In certain, more specific embodiments, a mammalian MPV is further characterized by its ability to cause the mammalian host to express proteins encoded by the genome of the mammalian MPV. In even more specific embodiments, the viral proteins expressed by the mammalian MPV are inserted into the cytoplasmic membranes of the mammalian host. In certain embodiments, the mammalian MPV of the invention can infect a mammalian host and cause the mammalian host to produce new infectious viral particles of the mammalian MPV. For a more detailed description of the functional characteristics of the mammalian MPV of the invention, see below.

In certain embodiments, the appearance of a virus in an electron microscope or its sensitivity to chloroform can be used to identify the virus as a mammalian MPV. The mammalian MPV of the invention appears in an electron microscope as paramyxovirus-like particle. Consistently, a mammalian MPV is sensitive to treatment with chloroform; a mammalian MPV is cultured optimally on tMK cells or cells functionally equivalent thereto and it is essentially trypsin dependent in most cell cultures. Furthermore, a mammalian MPV has a typical cytopathic effects (CPE) and lacks haemagglutinating activity against species of red blood cells. The CPE induced by MPV isolates are similar to the CPE induced by hRSV, with characteristic syncytia formation followed by rapid internal disruption of the cells and subsequent detachment from the culture plates. Although most paramyxoviruses have haemagglutinating activity, most of the pneumoviruses do not (Pringle, C.R. In: *The Paramyxoviruses*; (ed. D.W. Kingsbury) 1-39 (Plenum Press, New York, 1991)). A mammalian MPV contains a second overlapping ORF (M2-2) in the nucleic acid fragment

encoding the M2 protein. The occurrence of this second overlapping ORF occurs in other pneumoviruses as shown in Ahmadian *et al.*, 1999, *J. Gen. Vir.* 80:2011-2016.

In certain embodiments, a viral isolate can be identified as a mammalian MPV by the following method. A test sample can, *e.g.*, be obtained from an animal or human. The sample is then tested for the presence of a virus of the sub-family *Pneumovirinae*. If a virus of the sub-family *Pneumovirinae* is present, the virus can be tested for any of the characteristics of a mammalian MPV as discussed herein, such as, but not limited to, phylogenetic relatedness to a mammalian MPV, nucleotide sequence identity to a nucleotide sequence of a mammalian MPV, amino acid sequence identity/homology to a amino acid sequence of a mammalian MPV, and genomic organization. Furthermore, the virus can be identified as a mammalian MPV by cross-hybridization experiments using nucleic acid sequences from a MPV isolate, RT-PCR using primers specific to mammalian MPV, or in classical cross-serology experiments using antibodies directed against a mammalian MPV isolate. In certain other embodiments, a mammalian MPV can be identified on the basis of its immunological distinctiveness, as determined by quantitative neutralization with animal antisera. The antisera can be obtained from, *e.g.*, ferrets, pigs or macaques that are infected with a mammalian MPV.

In certain embodiments, the serotype does not cross-react with viruses other than mammalian MPV. In other embodiments, the serotype shows a homologous-to-heterologous titer ratio >16 in both directions. If neutralization shows a certain degree of cross-reaction between two viruses in either or both directions (homologous-to-heterologous titer ratio of eight or sixteen), distinctiveness of serotype is assumed if substantial biophysical/biochemical differences of DNA sequences exist. If neutralization shows a distinct degree of cross-reaction between two viruses in either or both directions (homologous-to-heterologous titer ratio of smaller than eight), identity of serotype of the isolates under study is assumed. Isolate I-2614, herein also known as MPV isolate 00-1 (as deposited with CNCM, Paris (SEQ ID NO:19)), can be used as prototype.

In certain embodiments, a virus can be identified as a mammalian MPV by means of sequence homology/identity of the viral proteins or nucleic acids in comparison with the amino acid sequence and nucleotide sequences of the viral isolates disclosed herein by sequence or deposit. In particular, a virus is identified as a mammalian MPV when the genome of the virus contains a nucleic acid sequence that has a percentage nucleic acid identity to a virus isolate deposited as I-2614 with CNCM, Paris which is higher than the

percentages identified herein for the nucleic acids encoding the L protein, the M protein, the N protein, the P protein, or the F protein as identified herein below in comparison with APV-C (see Table 4). (See, PCT WO 02/05302, at pp. 12 to 19, which is incorporated by reference herein. Without being bound by theory, it is generally known that viral species, especially RNA virus species, often constitute a quasi species wherein the members of a cluster of the viruses display sequence heterogeneity. Thus, it is expected that each individual isolate may have a somewhat different percentage of sequence identity when compared to APV-C.

The highest amino sequence identity between the proteins of MPV and any of the known other viruses of the same family to date is the identity between APV-C and human MPV. Between human MPV and APV-C, the amino acid sequence identity for the matrix protein is 87%, 88% for the nucleoprotein, 68% for the phosphoprotein, 81% for the fusion protein and 56-64% for parts of the polymerase protein, as can be deduced when comparing the sequences given in Figure 30, see also Table 4. Viral isolates that contain ORFs that encode proteins with higher homology compared to these maximum values are considered mammalian MPVs. It should be noted that, similar to other viruses, a certain degree of variation is found between different isolated of mammalian MPVs.

TABLE 4: Amino acid sequence identity between the ORFs of MPV and those of other paramyxoviruses .

	N	P	M	F	M2-1	M2-2	L
APV A	69	55	78	67	72	26	64
APV B	69	51	76	67	71	27	- ²
APV C	88	68	87	81	84	56	- ²
hRSVA	42	24	38	34	36	18	42
hRSV B	41	23	37	33	35	19	44
bRSV	42	22	38	34	35	13	44
PVM	45	26	37	39	33	12	- ²
others ³	7-11	4-9	7-10	10-18	- ⁴	- ⁴	13-14

Footnotes:

1. No sequence homologies were found with known G and SH proteins and were thus excluded
2. Sequences not available.

3. others: human parainfluenza virus type 2 and 3, Sendai virus, measles virus, nipah virus, phocine distemper virus, and New Castle Disease virus.
4. ORF absent in viral genome.

Any protein of a mammalian MPV can be used as an immunogen to generate antibodies to be used with the methods of the invention. In certain embodiments, an antibody to be used with the methods of treatment of the present invention bind immunospecifically to a protein of mammalian MPV as set forth below.

In certain embodiments, the amino acid sequence of the SH protein of the mammalian MPV is at least 30%, at least 35%, at least 40%, at least 45%, at least 50%, at least 55%, at least 60%, at least 65%, at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 98%, at least 99%, or at least 99.5% identical to the amino acid sequence of SEQ ID NO:382 (SH protein of isolate NL/1/00; see Table 5). The isolated negative-sense single stranded RNA metapneumovirus that comprises the SH protein that is at least 30% identical to SEQ ID NO:382 (SH protein of isolate NL/1/00; see Table 5) is capable of infecting a mammalian host. In certain embodiments, the isolated negative-sense single stranded RNA metapneumovirus that comprises the SH protein that is at least 30% identical to SEQ ID NO:382 (SH protein of isolate NL/1/00; see Table 5) is capable of replicating in a mammalian host. In certain embodiments, a mammalian MPV contains a nucleotide sequence that encodes a SH protein that is at least 30% identical to SEQ ID NO:382 (SH protein of isolate NL/1/00; see Table 5).

In certain embodiments, the amino acid sequence of the G protein of the mammalian MPV is at least 20%, at least 25%, at least 30%, at least 35%, at least 40%, at least 45%, at least 50%, at least 55%, at least 60%, at least 65%, at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 98%, at least 99%, or at least 99.5% identical to the amino acid sequence of SEQ ID NO:322 (G protein of isolate NL/1/00; see Table 5). The isolated negative-sense single stranded RNA metapneumovirus that comprises the G protein that is at least 20% identical to SEQ ID NO:322 (G protein of isolate NL/1/00; see Table 5) is capable of infecting a mammalian host. In certain embodiments, the isolated negative-sense single stranded RNA metapneumovirus that comprises the G protein that is at least 20% identical to SEQ ID NO:322 (G protein of isolate NL/1/00; see Table 5) is capable of replicating in a mammalian host. In certain embodiments, a mammalian MPV contains a

nucleotide sequence that encodes a G protein that is at least 20% identical to SEQ ID NO:322 (G protein of isolate NL/1/00; see Table 5).

In certain embodiments, the amino acid sequence of the L protein of the mammalian MPV is at least 85%, at least 90%, at least 95%, at least 98%, at least 99%, or at least 99.5% identical to the amino acid sequence of SEQ ID NO:330 (L protein of isolate NL/1/00; see Table 5). The isolated negative-sense single stranded RNA metapneumovirus that comprises the L protein that is at least 85% identical to SEQ ID NO:330 (L protein of isolate NL/1/00; see Table 5) is capable of infecting a mammalian host. In certain embodiments, the isolated negative-sense single stranded RNA metapneumovirus that comprises the L protein that is at least 85% identical to SEQ ID NO:330 (L protein of isolate NL/1/00; see Table 5) is capable of replicating in a mammalian host. In certain embodiments, a mammalian MPV contains a nucleotide sequence that encodes a L protein that is at least 20% identical to SEQ ID NO:330 (L protein of isolate NL/1/00; see Table 5).

In certain embodiments, the amino acid sequence of the N protein of the mammalian MPV is at least 90%, at least 95%, or at least 98% identical to the amino acid sequence of SEQ ID NO:366. The isolated negative-sense single stranded RNA metapneumovirus that comprises the N protein that is at least 90% identical in amino acid sequence to SEQ ID NO:366 is capable of infecting mammalian host. In certain embodiments, the isolated negative-sense single stranded RNA metapneumovirus that comprises the N protein that is 90% identical in amino acid sequence to SEQ ID NO:366 is capable of replicating in a mammalian host. The amino acid identity is calculated over the entire length of the N protein. In certain embodiments, a mammalian MPV contains a nucleotide sequence that encodes a N protein that is at least 90%, at least 95%, or at least 98% identical to the amino acid sequence of SEQ ID NO:366.

The amino acid sequence of the P protein of the mammalian MPV is at least 70%, at least 80%, at least 90%, at least 95% or at least 98% identical to the amino acid sequence of SEQ ID NO:374. The mammalian MPV that comprises the P protein that is at least 70% identical in amino acid sequence to SEQ ID NO:374 is capable of infecting a mammalian host. In certain embodiments, the mammalian MPV that comprises the P protein that is at least 70% identical in amino acid sequence to SEQ ID NO:374 is capable of replicating in a mammalian host. The amino acid identity is calculated over the entire length of the P protein. In certain embodiments, a mammalian MPV contains a nucleotide sequence that encodes a P

protein that is at least 70%, at least 80%, at least 90%, at least 95% or at least 98% identical to the amino acid sequence of SEQ ID NO:374.

The amino acid sequence of the M protein of the mammalian MPV is at least 90%, at least 95% or at least 98% identical to the amino acid sequence of SEQ ID NO:358. The mammalian MPV that comprises the M protein that is at least 90% identical in amino acid sequence to SEQ ID NO:358 is capable of infecting mammalian host. In certain embodiments, the isolated negative-sense single stranded RNA metapneumovirus that comprises the M protein that is 90% identical in amino acid sequence to SEQ ID NO:358 is capable of replicating in a mammalian host. The amino acid identity is calculated over the entire length of the M protein. In certain embodiments, a mammalian MPV contains a nucleotide sequence that encodes a M protein that is at least 90%, at least 95% or at least 98% identical to the amino acid sequence of SEQ ID NO:358.

The amino acid sequence of the F protein of the mammalian MPV is at least 85%, at least 90%, at least 95% or at least 98% identical to the amino acid sequence of SEQ ID NO:314. The mammalian MPV that comprises the F protein that is at least 85% identical in amino acid sequence to SEQ ID NO:314 is capable of infecting a mammalian host. In certain embodiments, the isolated negative-sense single stranded RNA metapneumovirus that comprises the F protein that is 85% identical in amino acid sequence to SEQ ID NO:314 is capable of replicating in mammalian host. The amino acid identity is calculated over the entire length of the F protein. In certain embodiments, a mammalian MPV contains a nucleotide sequence that encodes a F protein that is at least 85%, at least 90%, at least 95% or at least 98% identical to the amino acid sequence of SEQ ID NO:314.

The amino acid sequence of the M2-1 protein of the mammalian MPV is at least 85%, at least 90%, at least 95% or at least 98% identical to the amino acid sequence of SEQ ID NO:338. The mammalian MPV that comprises the M2-1 protein that is at least 85% identical in amino acid sequence to SEQ ID NO:338 is capable of infecting a mammalian host. In certain embodiments, the isolated negative-sense single stranded RNA metapneumovirus that comprises the M2-1 protein that is 85% identical in amino acid sequence to SEQ ID NO:338 is capable of replicating in a mammalian host. The amino acid identity is calculated over the entire length of the M2-1 protein. In certain embodiments, a mammalian MPV contains a nucleotide sequence that encodes a M2-1 protein that is at least 85%, at least 90%, at least 95% or at least 98% identical to the amino acid sequence of SEQ ID NO:338.

The amino acid sequence of the M2-2 protein of the mammalian MPV is at least 60%, at least 70%, at least 80%, at least 90%, at least 95% or at least 98% identical to the amino acid sequence of SEQ ID NO:346. The isolated mammalian MPV that comprises the M2-2 protein that is at least 60% identical in amino acid sequence to SEQ ID NO:346 is capable of infecting mammalian host. In certain embodiments, the isolated negative-sense single stranded RNA metapneumovirus that comprises the M2-2 protein that is 60% identical in amino acid sequence to SEQ ID NO:346 is capable of replicating in a mammalian host. The amino acid identity is calculated over the entire length of the M2-2 protein. In certain embodiments, a mammalian MPV contains a nucleotide sequence that encodes a M2-1 protein that is at least 60%, at least 70%, at least 80%, at least 90%, at least 95% or at least 98% identical to the amino acid sequence of SEQ ID NO:346.

In certain embodiments, the negative-sense single stranded RNA metapneumovirus encodes at least two proteins, at least three proteins, at least four proteins, at least five proteins, or six proteins selected from the group consisting of (i) a N protein with at least 90% amino acid sequence identity to SEQ ID NO:366; (ii) a P protein with at least 70% amino acid sequence identity to SEQ ID NO:374 (iii) a M protein with at least 90% amino acid sequence identity to SEQ ID NO:358 (iv) a F protein with at least 85% amino acid sequence identity to SEQ ID NO:314 (v) a M2-1 protein with at least 85% amino acid sequence identity to SEQ ID NO:338; and (vi) a M2-2 protein with at least 60% amino acid sequence identity to SEQ ID NO:346.

Mammalian MPV, can be divided into two subgroups, subgroup A and subgroup B, and the two subgroups can each be divided into two variants, A1 and A2, and B1 and B2. A mammalian MPV can be identified as a member of subgroup A if it is phylogenetically closer related to the isolate 00-1 (SEQ ID NO:19) than to the isolate 99-1 (SEQ ID NO:18). A mammalian MPV can be identified as a member of subgroup B if it is phylogenetically closer related to the isolate 99-1 (SEQ ID NO:18) than to the isolate 00-1 (SEQ ID NO:19). In other embodiments, nucleotide or amino acid sequence homologies of individual ORFs can be used to classify a mammalian MPV as belonging to subgroup A or B.

The different isolates of mammalian MPV can be divided into four different variants, variant A1, variant A2, variant B1 and variant B2 (*see* Figures 21 and 22). The isolate 00-1 (SEQ ID NO:19) is an example of the variant A1 of mammalian MPV. The isolate 99-1 (SEQ ID NO:18) is an example of the variant B1 of mammalian MPV. A mammalian MPV can be grouped into one of the four variants using a phylogenetic analysis. Thus, a

mammalian MPV belongs to a specific variant if it is phylogenetically closer related to a known member of that variant than it is phylogenetically related to a member of another variant of mammalian MPV. The sequence of any ORF and the encoded polypeptide may be used to type a MPV isolate as belonging to a particular subgroup or variant, including N, P, L, M, SH, G, M2 or F polypeptides. In a specific embodiment, the classification of a mammalian MPV into a variant is based on the sequence of the G protein. Without being bound by theory, the G protein sequence is well suited for phylogenetic analysis because of the high degree of variation among G proteins of the different variants of mammalian MPV.

In certain embodiments of the invention, sequence homology may be determined by the ability of two sequences to hybridize under certain conditions, as set forth below. A nucleic acid which is hybridizable to a nucleic acid of a mammalian MPV, or to its reverse complement, or to its complement can be used in the methods of the invention to determine their sequence homology and identities to each other. In certain embodiments, the nucleic acids are hybridized under conditions of high stringency.

It is well-known to the skilled artisan that hybridization conditions, such as, but not limited to, temperature, salt concentration, pH, formamide concentration (*see, e.g.,* Sambrook et al., 1989, Chapters 9 to 11, *Molecular Cloning, A Laboratory Manual*, 2d Ed., Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York, incorporated herein by reference in its entirety) . In certain embodiments, hybridization is performed in aqueous solution and the ionic strength of the solution is kept constant while the hybridization temperature is varied dependent on the degree of sequence homology between the sequences that are to be hybridized. For DNA sequences that 100% identical to each other and are longer than 200 basepairs, hybridization is carried out at approximately 15-25°C below the melting temperature (T_m) of the perfect hybrid. The melting temperature (T_m) can be calculated using the following equation (Bolton and McCarthy, 1962, *Proc. Natl. Acad. Sci. USA* 84:1390):

$$T_m = 81.5^{\circ}\text{C} - 16.6(\log_{10}[\text{Na}^{+}]) + (\%G+C) - 0.63(\%\text{formamide}) - (600/l)$$

Wherein (T_m) is the melting temperature, $[\text{Na}^{+}]$ is the sodium concentration, G+C is the Guanine and Cytosine content, and l is the length of the hybrid in basepairs. The effect of mismatches between the sequences can be calculated using the formula by Bonner et al. (Bonner et al., 1973, *J. Mol. Biol.* 81:123-135): for every 1% of mismatching of bases in the hybrid, the melting temperature is reduced by 1-1.5°C.

Thus, by determining the temperature at which two sequences hybridize, one of skill in the art can estimate how similar a sequence is to a known sequence. This can be done, e.g., by comparison of the empirically determined hybridization temperature with the hybridization temperature calculated for the known sequence to hybridize with its perfect match. Through the use of the formula by Bonner et al., the relationship between hybridization temperature and per cent mismatch can be exploited to provide information about sequence similarity.

By way of example and not limitation, procedures using such conditions of high stringency are as follows. Prehybridization of filters containing DNA is carried out for 8 h to overnight at 65 C in buffer composed of 6X SSC, 50 mM Tris-HCl (pH 7.5), 1 mM EDTA, 0.02% PVP, 0.02% Ficoll, 0.02% BSA, and 500 μ g/ml denatured salmon sperm DNA. Filters are hybridized for 48 h at 65 C in prehybridization mixture containing 100 μ g/ml denatured salmon sperm DNA and 5-20 X 10⁶ cpm of ³²P-labeled probe. Washing of filters is done at 37 C for 1 h in a solution containing 2X SSC, 0.01% PVP, 0.01% Ficoll, and 0.01% BSA. This is followed by a wash in 0.1X SSC at 50 C for 45 min before autoradiography. Other conditions of high stringency which may be used are well known in the art. In other embodiments of the invention, hybridization is performed under moderate or low stringency conditions, such conditions are well-known to the skilled artisan (*see e.g.*, Sambrook et al., 1989, *Molecular Cloning, A Laboratory Manual*, 2d Ed., Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York; *see also*, Ausubel et al., eds., in the *Current Protocols in Molecular Biology* series of laboratory technique manuals, 1987-1997 *Current Protocols*, © 1994-1997 John Wiley and Sons, Inc., each of which is incorporated by reference herein in their entirety). An illustrative low stringency condition is provided by the following system of buffers: hybridization in a buffer comprising 35% formamide, 5X SSC, 50 mM Tris-HCl (pH 7.5), 5 mM EDTA, 0.02% PVP, 0.02% Ficoll, 0.2% BSA, 100 μ g/ml denatured salmon sperm DNA, and 10% (wt/vol) dextran sulfate for 18-20 hours at 40°C, washing in a buffer consisting of 2X SSC, 25 mM Tris-HCl (pH 7.4), 5 mM EDTA, and 0.1% SDS for 1.5 hours at 55°C, and washing in a buffer consisting of 2X SSC, 25 mM Tris-HCl (pH 7.4), 5 mM EDTA, and 0.1% SDS for 1.5 hours at 60°C.

In certain embodiments, a mammalian MPV can be classified into one of the variants using probes that are specific for a specific variant of mammalian MPV. Such probes include primers for RT-PCR (Table 5) and antibodies.

In certain embodiments of the invention, the different variants of mammalian MPV can be distinguished from each other by way of the amino acid sequences of the different viral proteins. In other embodiments, the different variants of mammalian MPV can be distinguished from each other by way of the nucleotide sequences of the different ORFs encoded by the viral genome. A variant of mammalian MPV can be, but is not limited to, A1, A2, B1 or B2.

An isolate of mammalian MPV is classified as a variant B1 if it is phylogenetically closer related to the viral isolate NL/1/99 (SEQ ID NO:18) than it is related to any of the following other viral isolates: NL/1/00 (SEQ ID NO:19), NL/17/00 (SEQ ID NO:20) and NL/1/94 (SEQ ID NO:21). One or more of the ORFs of a mammalian MPV can be used to classify the mammalian MPV into a variant. A mammalian MPV can be classified as an MPV variant B1, if the amino acid sequence of its G protein is at least 66%, at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 98%, or at least 99% or at least 99.5% identical to the G protein of a mammalian MPV variant B1 as represented by the prototype NL/1/99 (SEQ ID NO:324); if the amino acid sequence of its N protein is at least 98.5% or at least 99% or at least 99.5% identical to the N protein of a mammalian MPV variant B1 as represented by the prototype NL/1/99 (SEQ ID NO:368); if the amino acid sequence of its P protein is at least 96%, at least 98%, or at least 99% or at least 99.5% identical to the P protein of a mammalian MPV variant B1 as represented by the prototype NL/1/99 (SEQ ID NO:376); if the amino acid sequence of its M protein is identical to the M protein of a mammalian MPV variant B1 as represented by the prototype NL/1/99 (SEQ ID NO:360); if the amino acid sequence of its F protein is at least 99% identical to the F protein of a mammalian MPV variant B1 as represented by the prototype NL/1/99 (SEQ ID NO:316); if the amino acid sequence of its M2-1 protein is at least 98% or at least 99% or at least 99.5% identical to the M2-1 protein of a mammalian MPV variant B1 as represented by the prototype NL/1/99 (SEQ ID NO:340); if the amino acid sequence of its M2-2 protein is at least 99% or at least 99.5% identical to the M2-2 protein of a mammalian MPV variant B1 as represented by the prototype NL/1/99 (SEQ ID NO:348); if the amino acid sequence of its SH protein is at least 83%, at least 85%, at least 90%, at least 95%, at least 98%, or at least 99% or at least 99.5% identical to the SH protein of a mammalian MPV variant B1 as represented by the prototype NL/1/99 (SEQ ID NO:384); and/or if the amino acid sequence of its L protein is at least 99% or at least 99.5% identical to the L protein a mammalian MPV variant B1 as represented by the prototype NL/1/99 (SEQ ID NO:332).

An isolate of mammalian MPV is classified as a variant A1 if it is phylogenetically closer related to the viral isolate NL/1/00 (SEQ ID NO:19) than it is related to any of the following other viral isolates: NL/1/99 (SEQ ID NO:18), NL/17/00 (SEQ ID NO:20) and NL/1/94 (SEQ ID NO:21). One or more of the ORFs of a mammalian MPV can be used to classify the mammalian MPV into a variant. A mammalian MPV can be classified as an MPV variant A1, if the amino acid sequence of its G protein is at least 66%, at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 98%, or at least 99% or at least 99.5% identical to the G protein of a mammalian MPV variant A1 as represented by the prototype NL/1/00 (SEQ ID NO:322); if the amino acid sequence of its N protein is at least 99.5% identical to the N protein of a mammalian MPV variant A1 as represented by the prototype NL/1/00 (SEQ ID NO:366); if the amino acid sequence of its P protein is at least 96%, at least 98%, or at least 99% or at least 99.5% identical to the P protein of a mammalian MPV variant A1 as represented by the prototype NL/1/00 (SEQ ID NO:374); if the amino acid sequence of its M protein is at least 99% or at least 99.5% identical to the M protein of a mammalian MPV variant A1 as represented by the prototype NL/1/00 (SEQ ID NO:358); if the amino acid sequence of its F protein is at least 98% or at least 99% or at least 99.5% identical to the F protein of a mammalian MPV variant A1 as represented by the prototype NL/1/00 (SEQ ID NO:314); if the amino acid sequence of its M2-1 protein is at least 99% or at least 99.5% identical to the M2-1 protein of a mammalian MPV variant A1 as represented by the prototype NL/1/00 (SEQ ID NO:338); if the amino acid sequence of its M2-2 protein is at least 96% or at least 99% or at least 99.5% identical to the M2-2 protein of a mammalian MPV variant A1 as represented by the prototype NL/1/00 (SEQ ID NO:346); if the amino acid sequence of its SH protein is at least 84%, at least 90%, at least 95%, at least 98%, or at least 99% or at least 99.5% identical to the SH protein of a mammalian MPV variant A1 as represented by the prototype NL/1/00 (SEQ ID NO:382); and/or if the amino acid sequence of its L protein is at least 99% or at least 99.5% identical to the L protein of a virus of a mammalian MPV variant A1 as represented by the prototype NL/1/00 (SEQ ID NO:330).

An isolate of mammalian MPV is classified as a variant A2 if it is phylogenetically closer related to the viral isolate NL/17/00 (SEQ ID NO:20) than it is related to any of the following other viral isolates: NL/1/99 (SEQ ID NO:18), NL/1/00 (SEQ ID NO:19) and NL/1/94 (SEQ ID NO:21). One or more of the ORFs of a mammalian MPV can be used to classify the mammalian MPV into a variant. A mammalian MPV can be classified as an

MPV variant A2, if the amino acid sequence of its G protein is at least 66%, at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 98%, at least 99% or at least 99.5% identical to the G protein of a mammalian MPV variant A2 as represented by the prototype NL/17/00 (SEQ ID NO:332); if the amino acid sequence of its N protein is at least 99.5% identical to the N protein of a mammalian MPV variant A2 as represented by the prototype NL/17/00 (SEQ ID NO:367); if the amino acid sequence of its P protein is at least 96%, at least 98%, at least 99% or at least 99.5% identical to the P protein of a mammalian MPV variant A2 as represented by the prototype NL/17/00 (SEQ ID NO:375); if the amino acid sequence of its M protein is at least 99%, or at least 99.5% identical to the M protein of a mammalian MPV variant A2 as represented by the prototype NL/17/00 (SEQ ID NO:359); if the amino acid sequence of its F protein is at least 98%, at least 99% or at least 99.5% identical to the F protein of a mammalian MPV variant A2 as represented by the prototype NL/17/00 (SEQ ID NO:315); if the amino acid sequence of its M2-1 protein is at least 99%, or at least 99.5% identical to the M2-1 protein of a mammalian MPV variant A2 as represented by the prototype NL/17/00 (SEQ ID NO: 339); if the amino acid sequence of its M2-2 protein is at least 96%, at least 98%, at least 99% or at least 99.5% identical to the M2-2 protein of a mammalian MPV variant A2 as represented by the prototype NL/17/00 (SEQ ID NO:347); if the amino acid sequence of its SH protein is at least 84%, at least 85%, at least 90%, at least 95%, at least 98%, at least 99% or at least 99.5% identical to the SH protein of a mammalian MPV variant A2 as represented by the prototype NL/17/00 (SEQ ID NO:383); if the amino acid sequence of its L protein is at least 99% or at least 99.5% identical to the L protein of a mammalian MPV variant A2 as represented by the prototype NL/17/00 (SEQ ID NO:331).

An isolate of mammalian MPV is classified as a variant B2 if it is phylogenetically closer related to the viral isolate NL/1/94 (SEQ ID NO:21) than it is related to any of the following other viral isolates: NL/1/99 (SEQ ID NO:18), NL/1/00 (SEQ ID NO:19) and NL/17/00 (SEQ ID NO:20). One or more of the ORFs of a mammalian MPV can be used to classify the mammalian MPV into a variant. A mammalian MPV can be classified as an MPV variant B2, if the amino acid sequence of its G protein is at least 66%, at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 98%, or at least 99% or at least 99.5% identical to the G protein of a mammalian MPV variant B2 as represented by the prototype NL/1/94 (SEQ ID NO:325); if the amino acid sequence of its N protein is at least 99% or at least 99.5% identical to the N protein of a mammalian MPV variant B2 as

represented by the prototype NL/1/94 (SEQ ID NO:369); if the amino acid sequence of its P protein is at least 96%, at least 98%, or at least 99% or at least 99.5% identical to the P protein of a mammalian MPV variant B2 as represented by the prototype NL/1/94 (SEQ ID NO:377); if the amino acid sequence of its M protein is identical to the M protein of a mammalian MPV variant B2 as represented by the prototype NL/1/94 (SEQ ID NO:361); if the amino acid sequence of its F protein is at least 99% or at least 99.5% identical to the F protein of a mammalian MPV variant B2 as represented by the prototype NL/1/94 (SEQ ID NO:317); if the amino acid sequence of the M2-1 protein is at least 98% or at least 99% or at least 99.5% identical to the M2-1 protein of a mammalian MPV variant B2 as represented by the prototype NL/1/94 (SEQ ID NO:341); if the amino acid sequence that is at least 99% or at least 99.5% identical to the M2-2 protein of a mammalian MPV variant B2 as represented by the prototype NL/1/94 (SEQ ID NO:349); if the amino acid sequence of its SH protein is at least 84%, at least 85%, at least 90%, at least 95%, at least 98%, or at least 99% or at least 99.5% identical to the SH protein of a mammalian MPV variant B2 as represented by the prototype NL/1/94 (SEQ ID NO:385); and/or if the amino acid sequence of its L protein is at least 99% or at least 99.5% identical to the L protein of a mammalian MPV variant B2 as represented by the prototype NL/1/94 (SEQ ID NO:333).

In certain embodiments, the percentage of sequence identity is based on an alignment of the full length proteins. In other embodiments, the percentage of sequence identity is based on an alignment of contiguous amino acid sequences of the proteins, wherein the amino acid sequences can be 25 amino acids, 50 amino acids, 75 amino acids, 100 amino acids, 125 amino acids, 150 amino acids, 175 amino acids, 200 amino acids, 225 amino acids, 250 amino acids, 275 amino acids, 300 amino acids, 325 amino acids, 350 amino acids, 375 amino acids, 400 amino acids, 425 amino acids, 450 amino acids, 475 amino acids, 500 amino acids, 750 amino acids, 1000 amino acids, 1250 amino acids, 1500 amino acids, 1750 amino acids, 2000 amino acids or 2250 amino acids in length.

FUNCTIONAL CHARACTERISTICS OF A MAMMALIAN MPV

In addition to the structural definitions of the mammalian MPV, a mammalian MPV can also be defined by its functional characteristics. In certain embodiments, a mammalian MPV is capable of infecting a mammalian host. The mammalian host can be a mammalian cell, tissue, organ or a mammal. In a specific embodiment, the mammalian host is a human or a human cell, tissue or organ. Any method known to the skilled artisan can be used to test

whether the mammalian host has been infected with the mammalian MPV. In certain embodiments, the virus is tested for its ability to attach to a mammalian cell. In certain other embodiments, the virus is tested for its ability to transfer its genome into the mammalian cell. In an illustrative embodiment, the genome of the virus is detectably labeled, *e.g.*, radioactively labeled. The virus is then incubated with a mammalian cell for at least 1 minute, at least 5 minutes at least 15 minutes, at least 30 minutes, at least 1 hour, at least 2 hours, at least 5 hours, at least 12 hours, or at least 1 day. The cells are subsequently washed to remove any viral particles from the cells and the cells are then tested for the presence of the viral genome by virtue of the detectable label. In another embodiment, the presence of the viral genome in the cells is detected using RT-PCR using mammalian MPV specific primers. (*See* , PCT WO 02/057302 at pp. 37 to 44, which is incorporated by reference herein).

In certain embodiments, a mammalian virus is capable to infect a mammalian host and to cause proteins of the mammalian MPV to be inserted into the cytoplasmic membrane of the mammalian host. The mammalian host can be a cultured mammalian cell, organ, tissue or mammal. In an illustrative embodiment, a mammalian cell is incubated with the mammalian virus. The cells are subsequently washed under conditions that remove the virus from the surface of the cell. Any technique known to the skilled artisan can be used to detect the newly expressed viral protein inserted in the cytoplasmic membrane of the mammalian cell. For example, after infection of the cell with the virus, the cells are maintained in medium comprising a detectably labeled amino acid. The cells are subsequently harvested, lysed, and the cytoplasmic fraction is separated from the membrane fraction. The proteins of the membrane fraction are then solubilized and then subjected to an immunoprecipitation using antibodies specific to a protein of the mammalian MPV, such as, but not limited to, the F protein or the G protein. The immunoprecipitated proteins are then subjected to SDS PAGE. The presence of viral protein can then be detected by autoradiography. In another embodiment, the presence of viral proteins in the cytoplasmic membrane of the host cell can be detected by immunocytochemistry using one or more antibodies specific to proteins of the mammalian MPV.

In even other embodiments, a mammalian MPV is capable of infecting a mammalian host and of replicating in the mammalian host. The mammalian host can be a cultured mammalian cell, organ, tissue or mammal. Any technique known to the skilled artisan can be used to determine whether a virus is capable of infecting a mammalian cell and of replicating

within the mammalian host. In a specific embodiment, mammalian cells are infected with the virus. The cells are subsequently maintained for at least 30 minutes, at least 1 hour, at least 2 hours, at least 5 hours, at least 12 hours, at least 1 day, or at least 2 days. The level of viral genomic RNA in the cells can be monitored using Northern blot analysis, RT-PCR or *in situ* hybridization using probes that are specific to the viral genome. An increase in viral genomic RNA demonstrates that the virus can infect a mammalian cell and can replicate within a mammalian cell.

In even other embodiments, a mammalian MPV is capable of infecting a mammalian host, wherein the infection causes the mammalian host to produce new infectious mammalian MPV. The mammalian host can be a cultured mammalian cell or a mammal. Any technique known to the skilled artisan can be used to determine whether a virus is capable of infecting a mammalian host and cause the mammalian host to produce new infectious viral particles. In an illustrative example, mammalian cells are infected with a mammalian virus. The cells are subsequently washed and incubated for at least 30 minutes, at least 1 hour, at least 2 hours, at least 5 hours, at least 12 hours, at least 1 day, at least 2 days, at least one week, or at least twelve days. The titer of virus can be monitored by any method known to the skilled artisan. For exemplary methods see section 5.8.

In certain, specific embodiments, a mammalian MPV is a human MPV. The tests described in this section can also be performed with a human MPV. In certain embodiments, the human MPV is capable of infecting a mammalian host, such as a mammal or a mammalian cultured cell.

In certain embodiments, a human MPV is capable to infect a mammalian host and to cause proteins of the human MPV to be inserted into the cytoplasmic membrane of the mammalian host.

In even other embodiments, a human MPV is capable of infecting a mammalian host and of replicating in the mammalian host.

In even other embodiments, the human MPV of the invention is capable of infecting a mammalian host and of replicating in the mammalian host, wherein the infection and replication causes the mammalian host to produce and package new infectious human MPV.

In certain embodiments, a mammalian MPV, even though it is capable of infecting a mammalian host, is also capable of infecting an avian host, such as a bird or an avian cultured cell. In certain embodiments, the mammalian MPV is capable to infect an avian host and to cause proteins of the mammalian MPV to be inserted into the cytoplasmic membrane of the

avian host. In even other embodiments, the mammalian MPV of the invention is capable of infecting an avian host and of replicating in the avian host. In even other embodiments, the mammalian MPV of the invention is capable of infecting an avian host and of replicating in the avian host, wherein the infection and replication causes the avian host to produce and package new infectious mammalian MPV.

A description of mammalian MPV can also be found in co-owned and co-pending U.S. Application Nos.: 10/371,099 and 10/371,122; both filed on February 21, 2003; both of which are incorporated herein by reference in their entireties.

4.1.7.2 Anti-hMPV Antibodies

An anti-hMPV-antigen antibody to be used with the methods of the invention can be an antibody that immunospecifically binds to hMPV nucleoprotein, hMPV phosphoprotein, hMPV matrix protein, hMPV small hydrophobic protein, hMPV RNA-dependent RNA polymerase, hMPV F protein, and hMPV G protein.

In certain embodiments, the anti-hMPV-antigen antibody binds immunospecifically to a hMPV antigen of a hMPV isolate from Canadian, to a hMPV isolate from The Netherlands, and/or to a hMPV antigen from a hMPV isolate from Australia. The different isolates are described in Peret et al, 2002, J Infect Dis 185:1660-1663, which is incorporated herein by reference in its entirety.

In certain embodiments, an anti-hMPV-antigen antibody binds to allelic variants of a hMPV nucleoprotein, hMPV phosphoprotein, hMPV matrix protein, hMPV small hydrophobic protein, hMPV RNA-dependent RNA polymerase, hMPV F protein, and/or hMPV G protein.

In certain embodiments, an antibody to be used with the methods of treatment of the invention is an antibody that immunospecifically binds to a mammalian MPV, or a protein of a mammalian MPV as described in section 4.1.7.1. In certain embodiments, an antibody to be used with the methods of treatment of the invention is an antibody that immunospecifically binds to a human MPV.

In certain embodiments, the anti-hMPV-antigen antibody binds immunospecifically to a protein/polypeptide that consists, *e.g.*, of an amino acid sequence of SEQ ID NOs: 399-406, 420, or 421, respectively.

In certain embodiments, the anti-hMPV-antigen antibody binds immunospecifically to a protein/polypeptide that consists of an amino acid sequence that is at least 60%, 70%, 80%,

90%, 95%, or at least 98% identical to the amino acid sequence of SEQ ID NOs: 399-406, 420, or 421, respectively. In certain embodiments, the anti-hMPV-antigen antibody binds immunospecifically to a protein/polypeptide that consists of an amino acid sequence that is at most 70%, 80%, 90%, 95%, 98% or at most 100% identical to the amino acid sequence of SEQ ID NOs: 399-406, 420, or 421, respectively.

In certain embodiments, the anti-hMPV-antigen antibody cross reacts with an APV antigen from APV associated with any avian, particularly turkey, duck, or chicken. In certain, more specific embodiments, the anti-hMPV-antibody cross-reacts with an antigen of APV-A, APV-B, APV-C, and/or APV-D, or any combination thereof, particularly turkey APV. In certain more specific embodiments, the anti-hMPV-antigen antibody cross-reacts with an antigen from a European APV isolate. In certain other embodiments, the anti-hMPV-antigen antibody cross-reacts with an antigen from a North American APV isolate. In certain embodiments, the anti-hMPV-antigen antibody cross-reacts with a APV nucleoprotein, APV phosphoprotein, APV matrix protein, APV small hydrophobic protein, APV RNA-dependent RNA polymerase, APV F protein, and/or APV G protein. In certain embodiments, the anti-hMPV-antigen antibody does not cross-react with an APV antigen. In certain embodiments, the anti-hMPV-antigen antibody cross reacts with an APV antigen of an amino acid sequence of, *e.g.*, SEQ ID NO:424 to 429, respectively.

In a specific embodiment, a monoclonal antibody against the F protein of hMPV is generated. In a more specific embodiment, the F protein of hMPV is produced using a baculovirus expression system (*e.g.*, the BD BaculoGold™ Baculovirus Expression Vector System can be used from BD Biosciences, NJ). In certain embodiments, the F protein is expressed without the transmembrane domain to induce secretion of the F protein from the cell in which the protein is expressed. Exemplary expression constructs that can be used for the expression of F protein for the generation of antibodies against the F protein are shown in Figure 1.

In certain embodiments, peptides that contain the following amino acid sequences are used for the generation of antibodies for use with the methods of the invention: amino acid 19 to 28; amino acid 94 to 106; amino acid 476 to 409, and/or amino acid 223 to 236 of SEQ ID NO:234 or SEQ ID NO:279. In certain embodiments, peptides that contain the amino acid sequences of SEQ ID NOs:430-437 are used as immunogens for the generation of antibodies for use with the methods of the invention. Without being bound by theory the sequences of

SEQ ID NOs:430-437 contain the heptad repeats of the F proteins of different strains of human metapneumoviruses.

In certain embodiments, an antibody to be used with the methods of the invention binds to a heptad repeat. In certain, more specific embodiments, an antibody to be used with the methods of the invention binds to a heptad repeat of the F protein of a mammalian metapneumovirus (*e.g.*, hMPV). In certain, even more specific embodiments, an antibody to be used with the methods of the invention binds to heptad repeat 1 or heptad repeat 2 of the F protein of a mammalian metapneumovirus (*e.g.*, hMPV). In certain embodiments, an antibody to be used with the methods of the invention binds to a heptad repeat of the F protein of APV.

Alignment of the human metapneumoviral F protein with the F protein of an avian pneumovirus isolated from Mallard Duck shows 85.6% identity in the ectodomain. Alignment of the human metapneumoviral F protein with the F protein of an avian pneumovirus isolated from Turkey (subgroup B) shows 75% identity in the ectodomain. See, *e.g.*, co-owned and co-pending Provisional Application No.: 60/358,934, entitled "Recombinant Parainfluenza Virus Expression Systems and Vaccines Comprising Heterologous Antigens Derived from Metapneumovirus", filed on February 21, 2002, by Haller and Tang, which is incorporated herein by reference in its entirety. Therefore, an antigen from avian metapneumovirus, and in particular the F protein from turkey metapneumovirus is a useful antigen for generating antibodies against human metapneumovirus.

In certain embodiments, the anti-hMPV-antigen antibody is a bispecific antibody. In certain embodiments, the bispecific antibody binds to two different epitopes of the same hMPV antigen. In certain other embodiments, the bispecific antibody binds to epitopes on two different hMPV antigens. In certain embodiments, the bispecific antibody binds immunospecifically to (i) a hMPV antigen and (ii) to an APV, a PIV, and/or a RSV antigen.

In certain embodiments, an antibody to be used with the methods of the invention is a bispecific antibody that binds to the F protein of RSV and to the F protein of hMPV. The bispecific antibody can be generated by chemical procedure or a recombinant approach. The antibody can be diabody, F(ab')₂, F(ab')₂ fused with lucine zippers, single chain diabodies, etc. The antibody can also be a multivalent antibody, such as quadruplebody. In certain embodiments, a bispecific antibody is constructed using Numax or Synagis for the part of the

antibody that binds the RSV F protein in combination with an antibody that binds the hMPV F protein.

4.1.7.3 Multiple Protein Monoclonal Antibodies

To generate multiple protein monoclonal antibodies, Balb/c or SJL mice (mice can be obtained, *e.g.*, from The Jackson Laboratory, Maine) are immunized first with live hMPV and later with adjuvanted hMPV, bovine PIV or purified F protein of hMPV. In a more specific embodiment, mice are immunized intranasally one to two times with hMPV followed by intraperitoneal injections with either hMPV (to produce all types of neutralizing antibodies, *e.g.*, F or G protein) or with intranasal immunization with bPIV/hMPV F or intraperitoneal immunization of purified F protein. bPIV/hMPV F is a chimeric virus wherein the coding sequence for the hMPV F protein is inserted into bovine PIV. A more detailed description of PIV vectors and their use as expression systems can be found in co-owned and co-pending U.S. Application Nos.: 10/371,264 and 10/373,567, both filed on February 21, 2003, both of which are incorporated herein by reference in their entireties. In certain specific embodiments, for each immunization 100 microliter of virus at 10^6 - 10^7 pfu/ml per mouse are used.

4.1.8 ANTI-PIV-ANTIGEN ANTIBODIES

In certain embodiments, an anti-PIV-antigen antibody binds immunospecifically to a PIV nucleocapsid structural protein, a PIV fusion glycoprotein, a PIV phosphoprotein, a PIV L protein, a PIV matrix protein, a PIV HN glycoprotein, a PIV RNA-dependent RNA polymerase, a PIV Y1 protein, a PIV D protein, a F glycoprotein, a PIV hemagglutinin-neuraminidase, or a PIV C protein.

In certain embodiments, the anti-PIV-antigen antibody binds to an antigen of PIV type 1, PIV type 2, and/or PIV type 3, or any combination thereof.

In certain embodiments, an anti-PIV-antigen antibody binds to allelic variants of a PIV nucleocapsid structural protein, a PIV fusion glycoprotein, a PIV phosphoprotein, a PIV L protein, a PIV matrix protein, a PIV HN glycoprotein, a PIV RNA-dependent RNA polymerase, a PIV Y1 protein, a PIV D protein, a F glycoprotein, a PIV hemagglutinin-neuraminidase, or a PIV C protein.

In certain embodiments, the anti-PIV-antigen antibody binds immunospecifically to a PIV RNA polymerase alpha subunit (Nucleocapsid phosphoprotein), *e.g.*, having an amino

acid sequence of SEQ ID NO:407; a PIV L polymerase protein, *e.g.*, having an amino acid sequence of SEQ ID NO:408; a PIV HN glycoprotein, *e.g.*, having an amino acid sequence of SEQ ID NO:409; a PIV matrix protein, *e.g.*, having an amino acid sequence of SEQ ID NO:410; a PIV Y1 protein, *e.g.*, having an amino acid sequence of SEQ ID NO:411; a PIV C protein, *e.g.*, having an amino acid sequence of SEQ ID NO:412; a PIV phosphoprotein, *e.g.*, having an amino acid sequence of SEQ ID NO:413; a PIV nucleoprotein, *e.g.*, having an amino acid sequence of SEQ ID NO:414; a PIV F glycoprotein, *e.g.*, having an amino acid sequence of SEQ ID NO:415; a PIV D protein, *e.g.*, having an amino acid sequence of SEQ ID NO:416; a PIV hemagglutinin-neuraminidase, *e.g.*, having an amino acid sequence of SEQ ID NO:417; a PIV nucleocapsid protein, *e.g.*, having an amino acid sequence of SEQ ID NO:418; a PIV P protein, *e.g.*, having an amino acid sequence of SEQ ID NO:419.

In certain embodiments, the anti-PIV-antigen antibody binds immunospecifically to a protein/polypeptide that consists of an amino acid sequence that is at least 60%, 70%, 80%, 90%, 95%, or at least 98% identical to the amino acid sequence of an RNA polymerase alpha subunit (Nucleocapsid phosphoprotein) SEQ ID NO:407; L polymerase protein SEQ ID NO:408; HN glycoprotein SEQ ID NO:409; matrix protein SEQ ID NO:410; Y1 protein SEQ ID NO:411; C protein SEQ ID NO:412; phosphoprotein SEQ ID NO:413; nucleoprotein SEQ ID NO:414; F glycoprotein SEQ ID NO:415; D protein SEQ ID NO:416; hemagglutinin-neuraminidase SEQ ID NO:417; nucleocapsid protein SEQ ID NO:418; P protein SEQ ID NO:419. In certain embodiments, the anti-PIV-antigen antibody binds immunospecifically to a protein/polypeptide that consists of an amino acid sequence that is at most 70%, 80%, 90%, 95%, 98% or at most 100% identical to the amino acid sequence of an RNA polymerase alpha subunit (Nucleocapsid phosphoprotein) SEQ ID NO:407; L polymerase protein SEQ ID NO:408; HN glycoprotein SEQ ID NO:409; matrix protein SEQ ID NO:410; Y1 protein SEQ ID NO:411; C protein SEQ ID NO:412; phosphoprotein SEQ ID NO:413; nucleoprotein SEQ ID NO:414; F glycoprotein SEQ ID NO:415; D protein SEQ ID NO:416; hemagglutinin-neuraminidase SEQ ID NO:417; nucleocapsid protein SEQ ID NO:418; P protein SEQ ID NO:419.

4.2 PROPHYLAXIS AND THERAPY OF RESPIRATORY VIRAL INFECTIONS

The invention provides methods for broad-spectrum treatment and prevention of respiratory viral infections. To obtain broad-spectrum protection against respiratory viral infection in a subject, a plurality of antibodies, each of which can bind immunospecifically to

an epitope on a different virus that causes respiratory infections, is administered to the subject. In certain embodiments, a plurality of antibodies that bind immunospecifically to antigens of different viruses that cause respiratory infections is administered. In certain embodiments, a plurality of antibodies that bind immunospecifically to different antigens of hMPV, PIV, and/or RSV, is administered. In certain embodiments, antibodies that cross-react with antigens from different respiratory viruses are administered. In specific embodiments, an antibody that immunospecifically binds to an antigen of hMPV cross reacts with an antigen of APV, particularly turkey APV. More specifically, an antibody that binds immunospecifically to the F protein of hMPV cross-reacts with the F protein of APV.

In certain embodiments, at least one of the antibodies to be administered to a subject is an antibody-conjugate.

Administering different antibodies with different immunospecificities ensures that the prophylaxis/therapy is effective against respiratory viruses even if some antigens of the viruses have modified amino acid sequences. In general there are two approaches to ensure that at least one of the administered plurality of antibodies binds immunospecifically to one or more of the infectious respiratory viral particles. First, antibodies against different epitopes of one or more viruses may be included in the plurality of antibodies. Thus, even if one of the epitopes of the infectious respiratory viral particle is different from the corresponding epitope against which one of the antibodies was raised, another antibody of the plurality of antibodies binds immunospecifically to an epitope of the infectious respiratory viral particle. In certain embodiments, even if one of the antigens of the infectious respiratory viral particle is different from the corresponding antigen against which one of the antibodies of the plurality of antibodies was raised, another antibody of the plurality of antibodies binds immunospecifically to an antigen of the infectious respiratory viral particle. Secondly, antibodies that cross-react with different antigens from different viruses, such as the F protein from RSV and the F protein from hMPV can be included in the plurality of antibodies to broaden the spectrum of viruses, subtypes of viruses, subgroups of viruses, mutated viruses, groups of viruses, and types of viruses against which the plurality of antibodies is effective.

In certain embodiment of the invention, the antibodies that are administered to the subject have a synergistic effect in treating and/or preventing an respiratory viral infection. In certain embodiments, the combination of a variety of antibodies is effective in treating or

preventing a respiratory viral infection while the individual administration of only one antibody is not effective in treating or preventing a respiratory viral infection.

In certain embodiments, the methods of the invention include administering (i) one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof; (ii) one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof; and/or (iii) one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof; and (iv) one or more vaccines directed against viruses that cause respiratory infections. In a specific embodiment, the vaccine is directed against hMPV. Such vaccines are described in U.S. Provisional Application No.: 60/358,934, entitled "Recombinant Parainfluenza Virus Expression Systems and Vaccines Comprising Heterologous Antigens Derived from Metapneumovirus", filed February 21, 2002, which is incorporated by reference in its entirety herein.

In certain other embodiments, the methods further include administering an anti-viral agent. Anti-viral agents include, but are not limited to, nucleoside analogs, such as zidovudine, acyclovir, gancyclovir, vidarabine, idoxuridine, trifluridine, and ribavirin, as well as foscarnet, amantadine, rimantadine, saquinavir, indinavir, ritonavir, and the alpha-interferons.

4.2.1 COMBINATION PROPHYLAXIS AND THERAPY WITH ANTI-RSV-ANTIGEN ANTIBODIES, ANTI-HMPV-ANTIGEN ANTIBODIES, AND ANTI-PIV-ANTIGEN ANTIBODIES

In certain embodiments, the invention provides methods for preventing, treating and/or ameliorating one or more symptoms of a respiratory viral infection in a subject, the method comprising administering to the subject one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof, one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof, and one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof. In specific embodiments, the invention provides administering to a subject a prophylactically effective amount of one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof, a prophylactically effective amount of one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof, and a prophylactically effective amount of one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof to prevent a respiratory viral infection in a subject. In specific embodiments, the invention provides administering to a subject a therapeutically effective amount of one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof, a therapeutically effective amount of one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof, and a therapeutically effective amount of one or more anti-hMPV-antigen antibodies or antigen-

binding fragments thereof to treat a respiratory viral infection in a subject. In specific embodiments of the invention, the respiratory viral infection is an infection with RSV, PIV, and/or hMPV. In certain embodiments, the subject is exposed to a risk of infection with RSV, PIV, and/or hMPV.

In certain embodiments, the invention provides methods of passive immunotherapy, wherein the methods comprises administering a first dose of one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof, a second dose of one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof, and a third dose of one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof and wherein the first dose reduces the incidence of a RSV infection by at least 25%, wherein the second dose reduces the incidence of a PIV infection by at least 25%, and wherein the third dose reduces the incidence of a hMPV infection by at least 25%. In certain embodiments, the first dose reduces the incidence of a RSV infection by at least 10%, 15%, 20%, 30%, 40%, 50%, 60%, 70%, 75%, 80%, 90%, 95%, or by at least 98%, wherein the second dose reduces the incidence of a PIV infection by at least 10%, 15%, 20%, 30%, 40%, 50%, 60%, 70%, 75%, 80%, 90%, 95%, or by at least 98%, and wherein the third dose reduces the incidence of a hMPV infection by at least 10%, 15%, 20%, 30%, 40%, 50%, 60%, 70%, 75%, 80%, 90%, 95%, or by at least 98%.

In certain embodiments, the invention provides a method of passive immunotherapy wherein the method comprises administering to a subject: (i) a first dose of one or more first antibodies or antigen-binding fragments thereof, wherein said one or more first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen; (ii) a second dose of one or more second antibodies or antigen-binding fragments thereof, wherein said one or more second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen, and (iii) a third dose of one or more third antibodies wherein the one or more third antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen, wherein the serum titer of said one or more first antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering said one or more first antibodies or antigen-binding fragments thereof, wherein the serum titer of said one or more second antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering said one or more second antibodies or antigen-binding fragments thereof, and wherein the serum titer of said one or more third antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of

administering said one or more second antibodies or antigen-binding fragments thereof. In certain embodiments, the serum titer of said one or more first antibodies or antigen-binding fragments thereof in the subject is at least 0.1 $\mu\text{g/ml}$, 0.5 $\mu\text{g/ml}$, 1 $\mu\text{g/ml}$, 5 $\mu\text{g/ml}$, 10 $\mu\text{g/ml}$, 20 $\mu\text{g/ml}$, 30 $\mu\text{g/ml}$, 40 $\mu\text{g/ml}$, 50 $\mu\text{g/ml}$, 75 $\mu\text{g/ml}$, 100 $\mu\text{g/ml}$, 150 $\mu\text{g/ml}$, 250 $\mu\text{g/ml}$, or at least 500 $\mu\text{g/ml}$ after 15 days of administering said one or more first antibodies or antigen-binding fragments thereof, wherein the serum titer of said one or more second antibodies or antigen-binding fragments thereof in the subject is at least 0.1 $\mu\text{g/ml}$, 0.5 $\mu\text{g/ml}$, 1 $\mu\text{g/ml}$, 5 $\mu\text{g/ml}$, 10 $\mu\text{g/ml}$, 20 $\mu\text{g/ml}$, 30 $\mu\text{g/ml}$, 40 $\mu\text{g/ml}$, 50 $\mu\text{g/ml}$, 75 $\mu\text{g/ml}$, 100 $\mu\text{g/ml}$, 150 $\mu\text{g/ml}$, 250 $\mu\text{g/ml}$, or at least 500 $\mu\text{g/ml}$ after 15 days of administering said one or more second antibodies or antigen-binding fragments thereof, and wherein the serum titer of said one or more third antibodies or antigen-binding fragments thereof in the subject is at least 0.1 $\mu\text{g/ml}$, 0.5 $\mu\text{g/ml}$, 1 $\mu\text{g/ml}$, 5 $\mu\text{g/ml}$, 10 $\mu\text{g/ml}$, 20 $\mu\text{g/ml}$, 30 $\mu\text{g/ml}$, 40 $\mu\text{g/ml}$, 50 $\mu\text{g/ml}$, 75 $\mu\text{g/ml}$, 100 $\mu\text{g/ml}$, 150 $\mu\text{g/ml}$, 250 $\mu\text{g/ml}$, or at least 500 $\mu\text{g/ml}$ after 15 days of administering said one or more second antibodies or antigen-binding fragments thereof.

In certain embodiments, the one or more anti-RSV-antigen antibodies, the one or more anti-PIV-antigen antibodies, and the one or more anti-hMPV-antigen antibodies, or any combination of these antibodies, are administered concurrently. In certain, more specific embodiments, the antibodies are administered concurrently via the same route, *e.g.*, but not limited to, intravenous or intramuscular. In certain other embodiments, the antibodies are administered concurrently via different routes.

In other embodiments, the one or more anti-RSV-antigen antibodies, the one or more anti-PIV-antigen antibodies, and the one or more anti-hMPV-antigen antibodies are administered subsequent to each other separated by a time period. In certain embodiments, the time period is 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, 1 week, 2 weeks, 3 weeks, 1 month, 2 months, or 3 months. In a specific embodiment of the invention, the one or more anti-RSV-antigen antibodies are administered first, the one or more anti-PIV-antigen antibodies are administered second, and the one or more anti-hMPV-antigen antibodies are administered third. In a specific embodiment of the invention, the one or more anti-hMPV-antigen antibodies are administered first, the one or more anti-RSV-antigen antibodies are administered second, and the one or more anti-PIV-antigen antibodies are administered third. In a specific embodiment of the invention, the one or more anti-PIV-antigen antibodies are administered first, the one or more anti-hMPV-antigen antibodies are administered second, and the one or more anti-RSV-antigen antibodies are administered third. In certain

embodiments, at least one of the antibodies is administered in a sequence of several administrations separated by a time period. Any other order of administration is also encompassed by the methods of the present invention.

The one or more anti-PIV-antigen antibodies, the one or more anti-hMPV-antigen antibodies, and the one or more anti-RSV-antigen antibodies can also be cyclically administered. Cycling therapy involves the administration of a first prophylactic or therapeutic agent for a period of time, followed by the administration of a second prophylactic or therapeutic agent for a period of time, followed by the administration of a third prophylactic or therapeutic agent for a period of time and so forth, and repeating this sequential administration, *i.e.*, the cycle, in order to reduce the development of resistance to one of the agents, to avoid or reduce the side effects of one of the agents, and/or to improve the efficacy of the treatment.

In certain embodiments, administration of the same antibody may be repeated and the administrations may be separated by at least 10 days, 15 days, 30 days, 2 months, 3 months, or at least 6 months. In certain embodiments, administration of the same antibody may be repeated and the administrations may be separated by at most 10 days, 15 days, 30 days, 2 months, 3 months, or at least 6 months.

4.2.2 COMBINATION PROPHYLAXIS AND THERAPY WITH ANTI-RSV-ANTIGEN ANTIBODIES AND ANTI-HMPV-ANTIGEN ANTIBODIES

The present invention provides methods of preventing and/or treating and ameliorating one or more symptoms associated with a respiratory viral infection in a subject comprising administering to said subject (i) one or more first antibodies or antigen-binding fragments thereof which immunospecifically bind to one or more RSV antigens; and (ii) one or more second antibodies or antigen-binding fragments thereof which immunospecifically bind to one or more hMPV antigens. In a specific embodiment, the subject is a human. In a specific embodiment, the subject has a viral respiratory infection, in particular, is infected with RSV and/or hMPV. In a specific embodiment, the method prevents a subject from infection with RSV and/or hMPV. In a specific embodiment, the subject is susceptible to RSV and/or hMPV infection. In a specific embodiment, the subject is exposed to the risk of infection with RSV and/or hMPV infection.

In certain embodiments, the one or more first antibodies neutralize RSV. In certain embodiments, the one or more first antibodies neutralize at least 25%, at least 30%, at least 35%, at least 40%, at least 45%, at least 50%, at least 55%, at least 60%, at least 65%, at least

70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 98% or at least 99% of the RSV in an *in vitro* microneutralization assay (see below). In certain embodiments, the one or more first antibodies neutralize at least 25%, at most 30%, at most 35%, at most 40%, at most 45%, at most 50%, at most 55%, at most 60%, at most 65%, at most 70%, at most 75%, at most 80%, at most 85%, at most 90%, at most 95%, at most 98% or at most 99% of the RSV in an *in vitro* microneutralization assay (as described in section 4.8.4).

In certain embodiments, the one or more second antibodies neutralize hMPV. In certain embodiments, the one or more second antibodies neutralize at least 25%, at least 30%, at least 35%, at least 40%, at least 45%, at least 50%, at least 55%, at least 60%, at least 65%, at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 98% or at least 99% of the hMPV in an *in vitro* microneutralization assay (see below). In certain embodiments, the one or more first antibodies neutralize at least 25%, at most 30%, at most 35%, at most 40%, at most 45%, at most 50%, at most 55%, at most 60%, at most 65%, at most 70%, at most 75%, at most 80%, at most 85%, at most 90%, at most 95%, at most 98% or at most 99% of the hMPV in an *in vitro* microneutralization assay.

In certain embodiments, at least one of the one or more antibodies that bind immunospecifically to a RSV antigen is a high affinity and/or high avidity antibody and/or has a longer serum half-life. In certain embodiments, at least one of the one or more antibodies that bind immunospecifically to a hMPV antigen is a high affinity and/or high avidity antibody and/or has a longer serum half-life.

The high affinity and/or high avidity of the antibodies of the invention enable the use of lower doses of the antibodies compared to non-high affinity or non-high avidity for the amelioration of symptoms associated with RSV infection and/or hMPV infection. The use of lower doses of antibodies which immunospecifically bind to one or more RSV antigens and the use of lower doses of antibodies which immunospecifically bind to one or more hMPV antigens reduces the likelihood of adverse effects, as well as providing a more effective prophylaxis. Further, high affinity and/or high avidity of the antibodies enable less frequent administration of said antibodies than previously thought to be necessary for the prevention, neutralization, treatment and the amelioration of symptoms associated with RSV infection and hMPV infection, respectively.

In certain embodiments, the one or more antibodies that bind immunospecifically to a RSV antigen and/or the one or more antibodies that bind immunospecifically to a hMPV

antigen can be administered directly to the site of RSV infection. In particular, at least one of the antibodies can be administered by pulmonary delivery. Such a mode of administration can reduce the dosage and frequency of administration of the antibodies to a subject.

In certain embodiments, the serum titer of at least one of the administered antibodies is 1 $\mu\text{g/ml}$ or less, 2 $\mu\text{g/ml}$ or less, 5 $\mu\text{g/ml}$ or less, 6 $\mu\text{g/ml}$ or less, 10 $\mu\text{g/ml}$ or less, 15 $\mu\text{g/ml}$ or less, 20 $\mu\text{g/ml}$ or less, or 25 $\mu\text{g/ml}$ or less. In certain embodiments, the serum titer of at least one of the administered antibodies is at least 1 $\mu\text{g/ml}$, at least 2 $\mu\text{g/ml}$, at least 5 $\mu\text{g/ml}$, at least 6 $\mu\text{g/ml}$, at least 10 $\mu\text{g/ml}$, at least 15 $\mu\text{g/ml}$, at least 20 $\mu\text{g/ml}$, at least 25 $\mu\text{g/ml}$, at least 50 $\mu\text{g/ml}$, at least 100 $\mu\text{g/ml}$, at least 125 $\mu\text{g/ml}$, at least 150 $\mu\text{g/ml}$, at least 175 $\mu\text{g/ml}$, at least 200 $\mu\text{g/ml}$, at least 225 $\mu\text{g/ml}$, at least 250 $\mu\text{g/ml}$, at least 275 $\mu\text{g/ml}$, at least 300 $\mu\text{g/ml}$, at least 325 $\mu\text{g/ml}$, at least 350 $\mu\text{g/ml}$, at least 375 $\mu\text{g/ml}$, or at least 400 $\mu\text{g/ml}$. Preferably a serum titer or serum titer of 1 $\mu\text{g/ml}$ or less, 2 $\mu\text{g/ml}$ or less, 5 $\mu\text{g/ml}$ or less, 6 $\mu\text{g/ml}$ or less, 10 $\mu\text{g/ml}$ or less, 15 $\mu\text{g/ml}$ or less, 20 $\mu\text{g/ml}$ or less, or 25 $\mu\text{g/ml}$ or less is achieved approximately 20 days (preferably 25, 30, 35 or 40 days) after administration of a first dose of antibodies or antigen-binding fragments thereof which immunospecifically bind to a RSV antigen and/or to a hMPV antigen and without administration of any other doses of said antibodies or antigen-binding fragments thereof. Preferably a serum titer or serum titer of at least 1 $\mu\text{g/ml}$, at least 2 $\mu\text{g/ml}$, at least 5 $\mu\text{g/ml}$, at least 6 $\mu\text{g/ml}$, at least 10 $\mu\text{g/ml}$, at least 15 $\mu\text{g/ml}$, at least 20 $\mu\text{g/ml}$, at least 25 $\mu\text{g/ml}$, at least 50 $\mu\text{g/ml}$, at least 100 $\mu\text{g/ml}$, at least 125 $\mu\text{g/ml}$, at least 150 $\mu\text{g/ml}$, at least 175 $\mu\text{g/ml}$, at least 200 $\mu\text{g/ml}$, at least 225 $\mu\text{g/ml}$, at least 250 $\mu\text{g/ml}$, at least 275 $\mu\text{g/ml}$, at least 300 $\mu\text{g/ml}$, at least 325 $\mu\text{g/ml}$, at least 350 $\mu\text{g/ml}$, at least 375 $\mu\text{g/ml}$, or at least 400 $\mu\text{g/ml}$ is achieved approximately 20 days (preferably 25, 30, 35 or 40 days) after administration of a first dose of antibodies or antigen-binding fragments thereof which immunospecifically bind to a RSV antigen and/or to a hMPV antigen and without administration of any other doses of said antibodies or antigen-binding fragments thereof.

In specific embodiments, a serum titer in a non-primate mammal of at least 0.4 $\mu\text{g/ml}$, 1 $\mu\text{g/ml}$, 4 $\mu\text{g/ml}$, 10 $\mu\text{g/ml}$, 40 $\mu\text{g/ml}$, at least 80 $\mu\text{g/ml}$, at least 100 $\mu\text{g/ml}$, at least 120 $\mu\text{g/ml}$, at least 150 $\mu\text{g/ml}$, at least 200 $\mu\text{g/ml}$, at least 250 $\mu\text{g/ml}$, or at least 300 $\mu\text{g/ml}$, of one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to a RSV antigen and/or of one or more antibodies or antigen-binding fragments thereof that bind immunospecifically to a hMPV antigen is achieved at least 1 day after administering a dose of less than 20 mg/kg, 15 mg/kg, 10 mg/kg, less than 2.5 mg/kg, less than 1 mg/kg, or less

than 0.5 mg/kg of the antibodies or antibody fragments to the non-primate mammal. In another embodiment, a serum titer in a non-primate mammal of at least 150 $\mu\text{g/ml}$, at least 200 $\mu\text{g/ml}$, at least 250 $\mu\text{g/ml}$, at least 300 $\mu\text{g/ml}$, at least 350 $\mu\text{g/ml}$, or at least 400 $\mu\text{g/ml}$ of one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or more RSV antigens and/or that bind immunospecifically to a hMPV antigen is achieved at least 1 day after administering a dose of approximately 5 mg/kg, 10 mg/kg, 15 mg/kg, 20 mg/kg, 25 mg/kg, or 30 mg/kg of the antibodies or antibody fragments to the non-primate mammal.

In another embodiment, a serum titer in a primate of at least 0.4 $\mu\text{g/ml}$, 1 $\mu\text{g/ml}$, 10 $\mu\text{g/ml}$, 40 $\mu\text{g/ml}$, preferably at least 80 $\mu\text{g/ml}$, at least 100 $\mu\text{g/ml}$, at least 120 $\mu\text{g/ml}$, at least 150 $\mu\text{g/ml}$, at least 200 $\mu\text{g/ml}$, at least 250 $\mu\text{g/ml}$, or at least 300 $\mu\text{g/ml}$ of one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or more RSV antigens and/or to one or more hMPV antigens is achieved at least 30 days after administering a first dose of less than 5 mg/kg, 10 mg/kg, 15 mg/kg, 20 mg/kg, 25 mg/kg, or 30 mg/kg, preferably less than 3 mg/kg, less than 1 mg/kg, or less than 0.5 mg/kg of the antibodies or antigen-binding fragments thereof to the primate. In yet another embodiment, a serum titer in a primate of at least 200 $\mu\text{g/ml}$, at least 250 $\mu\text{g/ml}$, at least 300 $\mu\text{g/ml}$, at least 350 $\mu\text{g/ml}$, or at least 400 $\mu\text{g/ml}$ of one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or more RSV antigens and/or one or more hMPV antigens is achieved at least 30 days after administering a first dose of approximately 5 mg/kg, 10 mg/kg, 15 mg/kg, 20 mg/kg, 25 mg/kg, or 30 mg/kg of the antibodies or antigen-binding fragments thereof to the primate. In accordance with these embodiments, the primate is preferably a human.

The present invention provides methods for preventing, treating, or ameliorating one or more symptoms associated with a respiratory viral infection in a mammal, preferably a human, said methods comprising administering a first dose to said mammal of (i) a prophylactically or therapeutically effective amount of one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or more RSV antigens, and (ii) a prophylactically or therapeutically effective amount of one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or more hMPV antigens, wherein said effective amount is less than 1.5 mg/kg, 8 mg/kg, 15 mg/kg, 50 mg/kg, or less than 100 mg/kg or approximately this amount of said antibodies or antigen-binding fragments thereof and which results in a serum titer of greater than 40 $\mu\text{g/ml}$ 30 days after the

first administration and prior to any subsequent administration. In one embodiment, the respiratory viral infection in a human subject is prevented or treated, or one or more symptoms associated with the respiratory viral infection is ameliorated by administering (i) a first dose of less than 20 mg/kg, 15 mg/kg, 10 mg/kg, preferably less than 5 mg/kg, less than 3 mg/kg, or less than 1 mg/kg or approximately this amount of one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or more RSV antigens; and (ii) a second dose of less than 20 mg/kg, 15 mg/kg, 10 mg/kg, less than 5 mg/kg, less than 3 mg/kg, or less than 1 mg/kg or approximately this amount of one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or more hMPV antigens so that a serum antibody titer of at least 40 $\mu\text{g/ml}$, at least 80 $\mu\text{g/ml}$, or at least 120 $\mu\text{g/ml}$, at least 150 $\mu\text{g/ml}$, at least 200 $\mu\text{g/ml}$, at least 250 $\mu\text{g/ml}$, or at least 300 $\mu\text{g/ml}$ is achieved 30 days after the administration of the first dose of the antibodies or antibody fragments and prior to the administration of a subsequent dose. In another embodiment, a respiratory infection in a human subject is prevented or treated, or one or more symptoms associated with a respiratory viral infection is ameliorated by administering a first dose of approximately 15 mg/kg of (i) one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or more RSV antigens; and (ii) one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or more RSV antigens so that a serum antibody titer of at least 10 $\mu\text{g/ml}$, 25 $\mu\text{g/ml}$, 50 $\mu\text{g/ml}$, 75 $\mu\text{g/ml}$, or at least 100 $\mu\text{g/ml}$, at least 200 $\mu\text{g/ml}$, at least 250 $\mu\text{g/ml}$, at least 300 $\mu\text{g/ml}$, at least 350 $\mu\text{g/ml}$, or at least 400 $\mu\text{g/ml}$ is achieved 30 days after the administration of the first dose of the antibodies or antibody fragments and prior to the administration of a subsequent dose.

In certain embodiments, the respiratory viral infection is an infection with RSV and/or hMPV.

In certain embodiments of the invention, the fragments of the antibodies, *i.e.*, the one or more antibodies that bind immunospecifically to a RSV antigen and/or the one or more antibodies that bind immunospecifically to a hMPV antigen comprise a variable heavy ("VH") domain.

In certain embodiments of the invention, the fragments of the one or more antibodies that bind immunospecifically to a RSV antigen and/or the fragments of the one or more antibodies that bind immunospecifically to a hMPV antigen comprise a variable light ("VL").

In certain embodiments, at least one of the fragments or the antibodies comprises a VH domain and a VL domain.

In certain embodiments of the invention, the antibodies are administered via sustained release formulations.

In certain embodiments the one or more antibodies or antigen-binding fragments thereof that bind immunospecifically to one or more RSV antigens (hereafter “anti-RSV-antigen antibodies or antigen-binding fragments thereof”) and the one or more antibodies that bind immunospecifically to one or more hMPV antigens (hereafter “anti-hMPV-antigen antibodies or antigen-binding fragments thereof”) are administered concurrently. In certain, more specific embodiments, the antibodies are administered concurrently via the same route, *e.g.*, but not limited to, intravenous or intramuscular. In certain other embodiments, the antibodies are administered concurrently via different routes.

In certain other embodiments, the anti-RSV-antigen antibodies or antigen-binding fragments thereof are administered prior to the administration of the anti-hMPV-antigen antibodies or antigen-binding fragments thereof. In certain other embodiments, the anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered prior to the administration of the anti-RSV-antigen antibodies or antigen-binding fragments thereof.

In certain embodiments, the anti-RSV-antigen antibodies or antigen-binding fragments thereof are administered in a sequence of individual administrations separated by a time period and the anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered prior to, concurrently with, or subsequent to the sequence of administering the anti-RSV-antigen antibodies. In certain embodiments, the anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered in a sequence of individual administrations separated by a time period and the anti-RSV-antigen antibodies or antigen-binding fragments thereof are administered prior to, concurrently with, or subsequent to the sequence of administering the anti-hMPV-antigen antibodies. In certain embodiments, the time period is 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, 1 week, 2 weeks, 3 weeks, 1 month, 2 months, or 3 months.

In certain embodiments, both the anti-RSV-antigen antibodies or antigen-binding fragments thereof and the anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered in a sequence of individual administrations separated by a time period. In certain more specific embodiments, the two sequences of administrations are in phase with each other. In other embodiments, the two sequences are out-of-phase with each other.

The present invention provides compositions comprising (i) one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or more RSV antigens, and (ii) one or more antibodies or antigen-binding fragments thereof that bind immunospecifically to one or more hMPV antigen. In certain embodiments, the pharmaceutical composition further comprises a pharmaceutically acceptable carrier.

In certain embodiments, administration of the same antibody may be repeated and the administrations may be separated by at least 10 days, 15 days, 30 days, 2 months, 3 months, or at least 6 months. In certain embodiments, administration of the same antibody may be repeated and the administrations may be separated by at most 10 days, 15 days, 30 days, 2 months, 3 months, or at least 6 months.

4.2.3 COMBINATION PROPHYLAXIS AND THERAPY OF ANTI-PIV-ANTIGEN ANTIBODIES AND ANTI-HMPV-ANTIGEN ANTIBODIES

The present invention provides methods of preventing and/or treating and ameliorating one or more symptoms associated with a respiratory viral infection in a subject comprising administering to said subject (i) one or more first antibodies or antigen-binding fragments thereof which immunospecifically bind to one or more PIV antigens; and (ii) one or more second antibodies or antigen-binding fragments thereof which immunospecifically bind to one or more hMPV antigens. In a specific embodiment, the subject is a human infected with PIV and hMPV. In a specific embodiment, the method prevents a subject from infection with PIV and hMPV. In a specific embodiment, the subject is susceptible to PIV and hMPV infection.

In certain embodiments, the one or more first antibodies neutralize PIV. In certain embodiments, the one or more first antibodies neutralize at least 25%, at least 30%, at least 35%, at least 40%, at least 45%, at least 50%, at least 55%, at least 60%, at least 65%, at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 98% or at least 99% of the PIV in an *in vitro* microneutralization assay (see below). In certain embodiments, the one or more first antibodies neutralize at least 25%, at most 30%, at most 35%, at most 40%, at most 45%, at most 50%, at most 55%, at most 60%, at most 65%, at most 70%, at most 75%, at most 80%, at most 85%, at most 90%, at most 95%, at most 98% or at most 99% of the PIV in an *in vitro* microneutralization assay (as described in section 4.8.4).

In certain embodiments, the one or more second antibodies neutralize hMPV. In certain embodiments, the one or more second antibodies neutralize at least 25%, at least 30%, at least 35%, at least 40%, at least 45%, at least 50%, at least 55%, at least 60%, at least 65%, at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 98% or at least 99% of the hMPV in an *in vitro* microneutralization assay (see below). In certain embodiments, the one or more first antibodies neutralize at least 25%, at most 30%, at most 35%, at most 40%, at most 45%, at most 50%, at most 55%, at most 60%, at most 65%, at most 70%, at most 75%, at most 80%, at most 85%, at most 90%, at most 95%, at most 98% or at most 99% of the hMPV in an *in vitro* microneutralization assay.

In certain embodiments, at least one of the one or more antibodies that bind immunospecifically to a PIV antigen is a high affinity and/or high avidity antibody and/or has a longer serum half-life. In certain embodiments, at least one of the one or more antibodies that bind immunospecifically to a hMPV antigen is a high affinity and/or high avidity antibody and/or has a longer serum half-life.

The high affinity and/or high avidity of the antibodies of the invention enable the use of lower doses of the antibodies compared to non-high affinity or non-high avidity for the amelioration of symptoms associated with PIV infection and/or hMPV infection. The use of lower doses of antibodies which immunospecifically bind to one or more PIV antigens and the use of lower doses of antibodies which immunospecifically bind to one or more hMPV antigens reduces the likelihood of adverse effects, as well as providing a more effective prophylaxis. Further, high affinity and/or high avidity of the antibodies enable less frequent administration of said antibodies than previously thought to be necessary for the prevention, neutralization, treatment and the amelioration of symptoms associated with PIV infection and hMPV infection, respectively.

In certain embodiments, the one or more antibodies that bind immunospecifically to a PIV antigen and/or the one or more antibodies that bind immunospecifically to a hMPV antigen can be administered directly to the site of PIV infection. In particular, at least one of the antibodies can be administered by pulmonary delivery. Such a mode of administration can reduce the dosage and frequency of administration of the antibodies to a subject.

In certain embodiments, the serum titer of at least one of the administered antibodies is 1 $\mu\text{g/ml}$ or less, 2 $\mu\text{g/ml}$ or less, 5 $\mu\text{g/ml}$ or less, 6 $\mu\text{g/ml}$ or less, 10 $\mu\text{g/ml}$ or less, 15 $\mu\text{g/ml}$ or less, 20 $\mu\text{g/ml}$ or less, 25 $\mu\text{g/ml}$ or less, 100 $\mu\text{g/ml}$ or less, or 250 $\mu\text{g/ml}$ or less. In certain embodiments, the serum titer of at least one of the administered antibodies is at least 1 $\mu\text{g/ml}$,

at least 2 $\mu\text{g/ml}$, at least 5 $\mu\text{g/ml}$, at least 6 $\mu\text{g/ml}$, at least 10 $\mu\text{g/ml}$, at least 15 $\mu\text{g/ml}$, at least 20 $\mu\text{g/ml}$, at least 25 $\mu\text{g/ml}$, at least 50 $\mu\text{g/ml}$, at least 100 $\mu\text{g/ml}$, at least 125 $\mu\text{g/ml}$, at least 150 $\mu\text{g/ml}$, at least 175 $\mu\text{g/ml}$, at least 200 $\mu\text{g/ml}$, at least 225 $\mu\text{g/ml}$, at least 250 $\mu\text{g/ml}$, at least 275 $\mu\text{g/ml}$, at least 300 $\mu\text{g/ml}$, at least 325 $\mu\text{g/ml}$, at least 350 $\mu\text{g/ml}$, at least 375 $\mu\text{g/ml}$, or at least 400 $\mu\text{g/ml}$. Preferably a serum titer or serum titer of 1 $\mu\text{g/ml}$ or less, 2 $\mu\text{g/ml}$ or less, 5 $\mu\text{g/ml}$ or less, 6 $\mu\text{g/ml}$ or less, 10 $\mu\text{g/ml}$ or less, 15 $\mu\text{g/ml}$ or less, 20 $\mu\text{g/ml}$ or less, or 25 $\mu\text{g/ml}$ or less is achieved approximately 20 days (preferably 25, 30, 35 or 40 days) after administration of a first dose of antibodies or antigen-binding fragments thereof which immunospecifically bind to a PIV antigen and/or to a hMPV antigen and without administration of any other doses of said antibodies or antigen-binding fragments thereof. Preferably a serum titer or serum titer of at least 1 $\mu\text{g/ml}$, at least 2 $\mu\text{g/ml}$, at least 5 $\mu\text{g/ml}$, at least 6 $\mu\text{g/ml}$, at least 10 $\mu\text{g/ml}$, at least 15 $\mu\text{g/ml}$, at least 20 $\mu\text{g/ml}$, at least 25 $\mu\text{g/ml}$, at least 50 $\mu\text{g/ml}$, at least 100 $\mu\text{g/ml}$, at least 125 $\mu\text{g/ml}$, at least 150 $\mu\text{g/ml}$, at least 175 $\mu\text{g/ml}$, at least 200 $\mu\text{g/ml}$, at least 225 $\mu\text{g/ml}$, at least 250 $\mu\text{g/ml}$, at least 275 $\mu\text{g/ml}$, at least 300 $\mu\text{g/ml}$, at least 325 $\mu\text{g/ml}$, at least 350 $\mu\text{g/ml}$, at least 375 $\mu\text{g/ml}$, or at least 400 $\mu\text{g/ml}$ is achieved approximately 20 days (preferably 25, 30, 35 or 40 days) after administration of a first dose of antibodies or antigen-binding fragments thereof which immunospecifically bind to a PIV antigen and/or to a hMPV antigen and without administration of any other doses of said antibodies or antigen-binding fragments thereof.

In specific embodiments, a serum titer in a non-primate mammal of at least 0.4 $\mu\text{g/ml}$, 1 $\mu\text{g/ml}$, 4 $\mu\text{g/ml}$, 10 $\mu\text{g/ml}$, 40 $\mu\text{g/ml}$, at least 80 $\mu\text{g/ml}$, at least 100 $\mu\text{g/ml}$, at least 120 $\mu\text{g/ml}$, at least 150 $\mu\text{g/ml}$, at least 200 $\mu\text{g/ml}$, at least 250 $\mu\text{g/ml}$, or at least 300 $\mu\text{g/ml}$, of one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to a PIV antigen and/or of one or more antibodies or antigen-binding fragments thereof that bind immunospecifically to a hMPV antigen is achieved at least 1 day after administering a dose of less than 100 mg/kg, 50 mg/kg, 10 mg/kg, less than 2.5 mg/kg, less than 1 mg/kg, or less than 0.5 mg/kg of the antibodies or antibody fragments to the non-primate mammal. In another embodiment, a serum titer in a non-primate mammal of at least 150 $\mu\text{g/ml}$, at least 200 $\mu\text{g/ml}$, at least 250 $\mu\text{g/ml}$, at least 300 $\mu\text{g/ml}$, at least 350 $\mu\text{g/ml}$, or at least 400 $\mu\text{g/ml}$ of one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or more PIV antigens and/or that bind immunospecifically to a hMPV antigen is achieved at least 1 day after administering a dose of approximately 5 mg/kg of the antibodies or antibody fragments to the non-primate mammal.

In another embodiment, a serum titer in a primate of at least 0.4 $\mu\text{g/ml}$, 1 $\mu\text{g/ml}$, 4 $\mu\text{g/ml}$, 10 $\mu\text{g/ml}$, 40 $\mu\text{g/ml}$, preferably at least 80 $\mu\text{g/ml}$, at least 100 $\mu\text{g/ml}$, at least 120 $\mu\text{g/ml}$, at least 150 $\mu\text{g/ml}$, at least 200 $\mu\text{g/ml}$, at least 250 $\mu\text{g/ml}$, or at least 300 $\mu\text{g/ml}$ of one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or more PIV antigens and/or to one or more hMPV antigens is achieved at least 30 days after administering a first dose of less than 5 mg/kg, preferably less than 3 mg/kg, less than 1 mg/kg, or less than 0.5 mg/kg of the antibodies or antigen-binding fragments thereof to the primate. In yet another embodiment, a serum titer in a primate of at least 200 $\mu\text{g/ml}$, at least 250 $\mu\text{g/ml}$, at least 300 $\mu\text{g/ml}$, at least 350 $\mu\text{g/ml}$, or at least 400 $\mu\text{g/ml}$ of one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or more PIV antigens and/or one or more hMPV antigens is achieved at least 30 days after administering a first dose of approximately 15 mg/kg of the antibodies or antigen-binding fragments thereof to the primate. In accordance with these embodiments, the primate is preferably a human.

The present invention provides methods for preventing, treating, or ameliorating one or more symptoms associated with a respiratory viral infection in a mammal, preferably a human, said methods comprising administering a first dose to said mammal of (i) a prophylactically or therapeutically effective amount of one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or more PIV antigens, and (ii) a prophylactically or therapeutically effective amount of one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or more hMPV antigens, wherein said effective amount is less than 1.5 mg/kg, 15 mg/kg, 50 mg/kg, or 100 mg/kg or approximately this amount of said antibodies or antigen-binding fragments thereof and which results in a serum titer of greater than 0.4 $\mu\text{g/ml}$, 1 $\mu\text{g/ml}$, 4 $\mu\text{g/ml}$, 10 $\mu\text{g/ml}$, 40 $\mu\text{g/ml}$ 30 days after the first administration and prior to any subsequent administration. In one embodiment, the respiratory viral infection in a human subject is prevented or treated, or one or more symptoms associated with the respiratory viral infection is ameliorated by administering (i) a first dose of less than 100 mg/kg or less than 10 mg/kg, about 15 mg/kg less than 5 mg/kg, less than 3 mg/kg, or less than 1 mg/kg or approximately this amount of one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or more PIV antigens; and (ii) a first dose of less than 10 mg/kg, about 15 mg/kg less than 5 mg/kg, less than 3 mg/kg, or less than 1 mg/kg or approximately this amount of one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or

more hMPV antigens so that a serum antibody titer of at least 0.4 $\mu\text{g/ml}$, 1 $\mu\text{g/ml}$, 4 $\mu\text{g/ml}$, 10 $\mu\text{g/ml}$, 40 $\mu\text{g/ml}$, preferably at least 80 $\mu\text{g/ml}$, or at least 120 $\mu\text{g/ml}$, at least 150 $\mu\text{g/ml}$, at least 200 $\mu\text{g/ml}$, at least 250 $\mu\text{g/ml}$, or at least 300 $\mu\text{g/ml}$ is achieved 30 days after the administration of the first dose of the antibodies or antibody fragments and prior to the administration of a subsequent dose. In another embodiment, a respiratory infection in a human subject is prevented or treated, or one or more symptoms associated with a respiratory viral infection is ameliorated by administering a first dose of approximately 15 mg/kg of (i) one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or more PIV antigens; and (ii) one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or more PIV antigens so that a serum antibody titer of at least 1 $\mu\text{g/ml}$, 5 $\mu\text{g/ml}$, 10 $\mu\text{g/ml}$, 50 $\mu\text{g/ml}$, 75 $\mu\text{g/ml}$, or at least 100 $\mu\text{g/ml}$, at least 200 $\mu\text{g/ml}$, at least 250 $\mu\text{g/ml}$, at least 300 $\mu\text{g/ml}$, at least 350 $\mu\text{g/ml}$, or at least 400 $\mu\text{g/ml}$ is achieved 30 days after the administration of the first dose of the antibodies or antibody fragments and prior to the administration of a subsequent dose.

In certain embodiments, the respiratory viral infection is an infection with PIV and hMPV.

In certain embodiments of the invention, the fragments of the antibodies, *i.e.*, the one or more antibodies that bind immunospecifically to a PIV antigen and/or the one or more antibodies that bind immunospecifically to a hMPV antigen comprise a variable heavy ("VH") domain.

In certain embodiments of the invention, the fragments of the one or more antibodies that bind immunospecifically to a PIV antigen and/or the fragments of the one or more antibodies that bind immunospecifically to a hMPV antigen comprise a variable light ("VL").

In certain embodiments, at least one of the fragments or the antibodies comprises a VH domain and a VL domain.

In certain embodiments of the invention, the antibodies are administered via sustained release formulations.

In certain embodiments the one or more antibodies or antigen-binding fragments thereof that bind immunospecifically to one or more PIV antigens (hereafter "anti-PIV-antigen antibodies or antigen-binding fragments thereof") and the one or more antibodies that bind immunospecifically to one or more hMPV antigens (hereafter "anti-hMPV-antigen antibodies or antigen-binding fragments thereof") are administered concurrently. In certain, more specific embodiments, the antibodies are administered concurrently via the same route,

e.g., but not limited to, intravenous or intramuscular. In certain other embodiments, the antibodies are administered concurrently via different routes.

In certain other embodiments, the anti-PIV-antigen antibodies or antigen-binding fragments thereof are administered prior to the administration of the anti-hMPV-antigen antibodies or antigen-binding fragments thereof. In certain other embodiments, the anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered prior to the administration of the anti-PIV-antigen antibodies or antigen-binding fragments thereof.

In certain embodiments, the anti-PIV-antigen antibodies or antigen-binding fragments thereof are administered in a sequence of individual administrations separated by a time period and the anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered prior to, concurrently with, or subsequent to the sequence of administering the anti-PIV-antigen antibodies. In certain embodiments, the anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered in a sequence of individual administrations separated by a time period and the anti-PIV-antigen antibodies or antigen-binding fragments thereof are administered prior to, concurrently with, or subsequent to the sequence of administering the anti-hMPV-antigen antibodies. In certain embodiments, the time period is 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, 1 week, 2 weeks, 3 weeks, 1 month, 2 months, or 3 months.

In certain embodiments, both the anti-PIV-antigen antibodies or antigen-binding fragments thereof and the anti-hMPV-antigen antibodies or antigen-binding fragments thereof are administered in a sequence of individual administrations separated by a time period. In certain more specific embodiments, the two sequences of administrations are in phase with each other. In other embodiments, the two sequences are out-of-phase with each other.

The present invention provides compositions comprising (i) one or more antibodies or antigen-binding fragments thereof that immunospecifically bind to one or more PIV antigens, and (ii) one or more antibodies or antigen-binding fragments thereof that bind immunospecifically to one or more hMPV antigen. In certain embodiments, the pharmaceutical compositions further comprise a pharmaceutically acceptable carrier.

In certain embodiments, administration of the same antibody may be repeated and the administrations may be separated by at least 10 days, 15 days, 30 days, 2 months, 3 months, or at least 6 months. In certain embodiments, administration of the same antibody may be

repeated and the administrations may be separated by at most 10 days, 15 days, 30 days, 2 months, 3 months, or at least 6 months.

4.3 PROPHYLACTIC AND THERAPEUTIC USES OF ANTIBODIES

Antibodies to be used with the methods of the invention are anti-RSV-antigen antibodies, anti-PIV-antigen antibodies, and/or anti-hMPV-antigen antibodies.

The present invention is directed to antibody-based therapies which involve administering antibodies or antigen-binding fragments thereof to a mammal, preferably a human, for preventing, treating, or ameliorating one or more symptoms associated with a RSV, PIV, and/or hMPV infection. In particular, the methods of the invention comprise (i) administering one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof and one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof; (ii) administering one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof and one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof; or (iii) administering one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof, one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof, and one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof. Prophylactic and therapeutic compositions of the invention include, but are not limited to, (i) one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof and one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof; (ii) one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof and one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof; or (iii) one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof, one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof, and one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof. Antibodies to be used with the methods of the invention or fragments thereof may be provided in pharmaceutically acceptable compositions as known in the art or as described herein.

Antibodies or antigen-binding fragments thereof which do not prevent RSV, PIV, and/or hMPV from binding its host cell receptor but inhibit or downregulate RSV, PIV, and/or hMPV replication can also be administered to a mammal to treat, prevent or ameliorate one or more symptoms associated with a respiratory infection. The ability of an antibody or fragment thereof to inhibit or downregulate RSV, PIV, and/or hMPV replication may be determined by techniques described herein or otherwise known in the art. For

example, the inhibition or downregulation of RSV, PIV, and/or hMPV replication can be determined by detecting the RSV titer in the lungs of a mammal, preferably a human.

In a specific embodiment, an antibody to be used with the methods of the invention or fragments thereof inhibit or downregulate RSV, PIV, and/or hMPV replication by at least 99%, at least 95%, at least 90%, at least 85%, at least 80%, at least 75%, at least 70%, at least 60%, at least 50%, at least 45%, at least 40%, at least 35%, at least 30%, at least 25%, at least 20%, or at least 10% relative to RSV, PIV, and/or hMPV replication, respectively, in absence of said antibodies or antibody fragments. In another embodiment, a combination of antibodies, a combination of antibody fragments, or a combination of antibodies and antibody fragments inhibit or downregulate a RSV, PIV, and/or hMPV replication, respectively, by at least 99%, at least 95%, at least 90%, at least 85%, at least 80%, at least 75%, at least 70%, at least 60%, at least 50%, at least 45%, at least 40%, at least 35%, at least 30%, at least 25%, at least 20%, or at least 10% relative to RSV replication in absence of said antibodies and/or antibody fragments.

One or more antibodies of the present invention or fragments thereof that immunospecifically bind to one or more RSV antigens, one or more PIV antigens, and/or one or more hMPV antigens may be used locally or systemically in the body as a therapeutic. The antibodies to be used with the methods of this invention or fragments thereof may also be advantageously utilized in combination with other monoclonal or chimeric antibodies, or with lymphokines or hematopoietic growth factors (such as, *e.g.*, IL-2, IL-3 and IL-7), which, for example, serve to increase the number or activity of effector cells which interact with the antibodies. The antibodies to be used with the methods of this invention or fragments thereof may also be advantageously utilized in combination with other monoclonal or chimeric antibodies, or with lymphokines or hematopoietic growth factors (such as, *e.g.*, IL-2, IL-3 and IL-7), which, for example, serve to increase the immune response. The antibodies to be used with the methods of this invention or fragments thereof may also be advantageously utilized in combination with one or more drugs used to treat RSV infection such as, for example anti-viral agents. Antibodies to be used with the methods of the invention or fragments may be used in combination with one or more of the following drugs: NIH-351 (Gemini Technologies), RSVf-2 (Intracel), F-50042 (Pierre Fabre), T-786 (Trimeris), VP-36676 (ViroPharma), RFI-641 (American Home Products), VP-14637 (ViroPharma), PFP-1 and antiviral PFP-2 (American Home Products), RSV vaccine (Avant Immunotherapeutics), and F-50077 (Pierre Fabre). In certain embodiments, antibodies to be used with the methods

of the invention or fragments may be used in combination with the high affinity human monoclonal antibodies specific to RSV F-protein as disclosed in U.S. Patent No.: 5,811,524, by Brams et al., issued September 22, 1998, which is incorporated herein by reference in its entirety.

The antibodies to be used with the methods of the invention may be administered alone or in combination with other types of treatments (*e.g.*, hormonal therapy, immunotherapy, and anti-inflammatory agents). Generally, administration of products of a species origin or species reactivity (in the case of antibodies) that is the same species as that of the patient is preferred. Thus, in a preferred embodiment, human or humanized antibodies, fragments derivatives, analogs, or nucleic acids, are administered to a human patient for therapy or prophylaxis.

In certain embodiments, high affinity and/or potent *in vivo* inhibiting antibodies and/or neutralizing antibodies that immunospecifically bind to a RSV, PIV, and/or hMPV antigen, for both immunoassays directed to RSV, PIV, and/or hMPV, prevention of RSV, PIV, and/or hMPV infection and therapy for RSV, PIV, and/or hMPV infection are used.

In certain embodiments, the therapeutic and/or prophylactic methods of the invention are used to treat, prevent or ameliorate one or more symptoms associated with a respiratory viral infection in a human with cystic fibrosis, bronchopulmonary dysplasia, congenital heart disease, congenital immunodeficiency or acquired immunodeficiency, or to a human who has had a bone marrow transplant. In certain embodiments, the respiratory viral infection is an infection with RSV, PIV, and/or hMPV. In certain embodiments, the therapeutic and/or prophylactic methods of the invention are used to treat, prevent or ameliorate one or more symptoms associated with a respiratory viral infection in a human infant, preferably a human infant born prematurely or a human infant at risk of hospitalization for RSV infection to treat, prevent or ameliorate one or more symptoms associated with RSV infection. In certain embodiments, the therapeutic and/or prophylactic methods of the invention are used to treat, prevent or ameliorate one or more symptoms associated with a respiratory viral infection in the elderly or people in group homes (*e.g.*, nursing homes or rehabilitation centers).

In certain embodiments of the invention, the target population for the therapeutic methods of the invention is defined by age. In certain embodiments, the target population for the therapeutic methods of the invention is characterized by a disease or disorder in addition to a respiratory tract infection.

In a specific embodiment, the target population encompasses young children, below 2 years of age. In a more specific embodiment, the children below the age of 2 years do not suffer from illnesses other than respiratory tract infection.

In other embodiments, the target population encompasses patients above 5 years of age. In a more specific embodiment, the patients above the age of 5 years suffer from an additional disease or disorder including cystic fibrosis, leukaemia, and non-Hodgkin lymphoma, or recently received bone marrow or kidney transplantation.

In a specific embodiment of the invention, the target population encompasses subjects in which the hMPV infection is associated with immunosuppression of the hosts. In a specific embodiment, the subject is an immunocompromised individual. In a specific embodiment, a subject to be treated with the methods of the invention is also infected with HIV.

In a specific embodiment, the subject to be treated with the methods of the invention has been diagnosed with severe respiratory syncytial virus bronchitis. Without being bound by theory, an individual diagnosed with severe respiratory syncytial virus is also likely to be infected with hMPV. In a specific embodiment, the subject to be treated with the methods of the invention has been diagnosed with acute respiratory tract illness.

In certain embodiments, the target population for the methods of the invention encompasses the elderly.

In a specific embodiment, the subject to be treated or diagnosed with the methods of the invention was infected with hMPV in the winter months.

In certain embodiments, an effective amount of the anti-RSV-antigen antibodies, anti-PIV-antigen antibodies, and/or anti-hMPV-antigen antibodies or antibody fragments thereof reduces the RSV, PIV, and/or hMPV titers in the lung as measured, for example, by the concentration of RSV, PIV, and/or hMPV in sputum samples or a lavage from the lungs from a mammal. In certain embodiments, an effective amount of an antibody to be used with the invention is sufficient to induce an immune response in the mammal.

In certain embodiments, the antibodies to be used with the methods of the invention are administered via sustained release formulations.

In certain embodiments, an antibody to be used with the methods of the invention binds to a heptad repeat. In certain embodiments, an antibody to be used with the methods of the invention binds to a heptad repeat of RSV, PIV, or hMPV. In certain embodiments, an antibody to be used with the methods of the invention binds to a heptad repeat of the F

protein of RSV, PIV, or hMPV. In certain, more specific embodiments, an antibody to be used with the methods of the invention binds to a heptad repeat of the F protein of a mammalian metapneumovirus (*e.g.*, hMPV). In certain, even more specific embodiments, an antibody to be used with the methods of the invention binds to heptad repeat 1 or heptad repeat 2 of the F protein of a mammalian metapneumovirus (*e.g.*, hMPV).

In certain embodiments of the invention, an antibody that immunospecifically binds to an antigen of hMPV of subgroup A or subgroup B can be used with the methods of the invention. In certain embodiments of the invention, an antibody that immunospecifically binds to an antigen of hMPV of variant A1, A2, B1 or B2.

4.3.1 METHODS OF ADMINISTRATION OF ANTIBODIES

The invention provides methods of treatment, prophylaxis, and amelioration of one or more symptoms associated with respiratory viral infection by administering to a subject of an effective amount of one or more antibodies or fragment thereof, or pharmaceutical composition comprising one or more antibodies of the invention or fragment thereof. In particular, the antibodies to be used with the methods of the invention are administered as a mixture, *e.g.*, a composition comprising anti-RSV-antigen antibodies, anti-PIV-antigen antibodies, and/or anti-hMPV-antigen antibodies, or any combination thereof. In a preferred aspect, an antibody or fragment thereof is substantially purified (*i.e.*, substantially free from substances that limit its effect or produce undesired side-effects). The subject is preferably a mammal such as non-primate (*e.g.*, cows, pigs, horses, cats, dogs, rats etc.) and a primate (*e.g.*, monkey such as a cynomolgous monkey and a human). In a preferred embodiment, the subject is a human. In another preferred embodiment, the subject is a human infant or a human infant born prematurely. In more specific embodiments, the prematurely born infant was born between 30-35 weeks gestational age or between 35-40 weeks of gestational age. In a preferred embodiment, the prematurely born infant was born between 32 and 35 weeks of gestational age. In certain other embodiments, the prematurely born infant was born at less than 32 weeks gestational age. In certain other embodiments, the prematurely born infant was born at 35-38 weeks gestational age. In other embodiments, the subject is an infant born at 38-40 weeks gestational age or greater than 40 weeks gestational age. In another embodiment, the subject is a human with cystic fibrosis, bronchopulmonary dysplasia, congenital heart disease, congenital immunodeficiency or acquired immunodeficiency, a human who has had a bone marrow transplant, or an elderly human.

Various delivery systems are known and can be used to administer an antibody or an antigen-binding fragment thereof, *e.g.*, encapsulation in liposomes, microparticles, microcapsules, recombinant cells capable of expressing the antibody or antibody fragment, receptor-mediated endocytosis (see, *e.g.*, Wu and Wu, J. Biol. Chem. 262:4429-4432 (1987)), construction of a nucleic acid as part of a retroviral or other vector, etc. Methods of administering an antibody or fragment thereof, or pharmaceutical composition include, but are not limited to, parenteral administration (*e.g.*, intradermal, intramuscular, intraperitoneal, intravenous and subcutaneous), epidural, and mucosal (*e.g.*, intranasal and oral routes). In a specific embodiment, antibodies or antigen-binding fragments thereof, or pharmaceutical compositions are administered intramuscularly, intravenously, or subcutaneously. The compositions may be administered by any convenient route, for example by infusion or bolus injection, by absorption through epithelial or mucocutaneous linings (*e.g.*, oral mucosa, rectal and intestinal mucosa, etc.) and may be administered together with other biologically active agents. Administration can be systemic or local. In addition, pulmonary administration can also be employed, *e.g.*, by use of an inhaler or nebulizer, and formulation with an aerosolizing agent. See, *e.g.*, U.S. Patent Nos. 6,019,968, 5,985,320, 5,985,309, 5,934,272, 5,874,064, 5,855,913, 5,290,540, and 4,880,078; and PCT Publication Nos. WO 92/19244, WO 97/32572, WO 97/44013, WO 98/31346, and WO 99/66903, each of which is incorporated herein by reference in its entirety. In a preferred embodiment, an antibody or fragment thereof, or composition comprising the antibodies to be used with the methods of the invention using Alkermes AIR™ pulmonary drug delivery technology (Alkermes, Inc., Cambridge, MA).

In certain embodiments, an antibody or fragment thereof is packaged in a hermetically sealed container such as an ampoule or sachette indicating the quantity of antibody or antibody fragment. In one embodiment, each antibody or antibody fragment or combination thereof is supplied as a dry sterilized lyophilized powder or water free concentrate in a hermetically sealed container and can be reconstituted, *e.g.*, with water or saline to the appropriate concentration for administration to a subject. For stabilized liquid antibody formulations, see U.S. Provisional Patent Application Nos.: 60/388,920, filed on June 14, 2002, and 60/388,921, filed June 14, 2002, which are incorporated by reference herein in their entireties. Preferably, each antibody or antibody fragment or combination thereof is supplied as a dry sterile lyophilized powder in a hermetically sealed container at a unit dosage for each antibody of at least 5 mg, more preferably at least 10 mg, at least 15 mg, at

least 25 mg, at least 35 mg, at least 45 mg, at least 50 mg, or at least 75 mg. Each lyophilized antibody or antibody fragment or combination thereof should be stored at between 2 and 8°C in its original container and the antibody or antibody fragment should be administered within 12 hours, preferably within 6 hours, within 5 hours, within 3 hours, or within 1 hour after being reconstituted. In an alternative embodiment, an antibody or fragment thereof is supplied in liquid form in a hermetically sealed container indicating the quantity and concentration of the antibody or antibody fragment. Preferably, the liquid form of the antibody or fragment thereof or combination thereof is supplied in a hermetically sealed container at a concentration for each antibody least 1 mg/ml, more preferably at least 2.5 mg/ml, at least 5 mg/ml, at least 8 mg/ml, at least 10 mg/ml, at least 15 mg/ml, at least 25 mg/ml, at least 50 mg/ml, at least 100 mg/ml, at least 125 mg/ml, at least 150 mg/ml, at least 200 mg/ml, or at least 250 mg/ml, or approximately 2.5 mg/ml, 5 mg/ml, 8 mg/ml, 10 mg/ml, 15 mg/ml, 25 mg/ml, 50 mg/ml, 100 mg/ml, 125 mg/ml, 150 mg/ml, 200 mg/ml, or 250 mg/ml.

In a specific embodiment, it may be desirable to administer the antibodies locally to the area in need of treatment; this may be achieved by, for example, and not by way of limitation, local infusion, by injection, or by means of an implant, said implant being of a porous, non-porous, or gelatinous material, including membranes, such as sialastic membranes, or fibers. Preferably, when administering an antibody or fragment thereof, care must be taken to use materials to which the antibody or antibody fragment does not absorb. In a specific embodiment, the antibodies may be administered by pulmonary delivery.

In another embodiment, an antibody can be delivered in a vesicle, in particular a liposome (see Langer, *Science* 249:1527-1533 (1990); Treat *et al.*, in *Liposomes in the Therapy of Infectious Disease and Cancer*, Lopez-Berestein and Fidler (eds.), Liss, New York, pp. 353- 365 (1989); Lopez-Berestein, *ibid.*, pp. 317-327; see generally *ibid.*).

In yet another embodiment, an antibody can be delivered in a controlled release or sustained release system. In one embodiment, a pump may be used to achieve controlled or sustained release (see Langer, *supra*; Sefton, 1987, *CRC Crit. Rev. Biomed. Eng.* 14:20; Buchwald *et al.*, 1980, *Surgery* 88:507; Saudek *et al.*, 1989, *N. Engl. J. Med.* 321:574). In another embodiment, polymeric materials can be used to achieve controlled or sustained release of the antibodies of the invention or fragments thereof (see *e.g.*, *Medical Applications of Controlled Release*, Langer and Wise (eds.), CRC Pres., Boca Raton, Florida (1974);

Controlled Drug Bioavailability, Drug Product Design and Performance, Smolen and Ball (eds.), Wiley, New York (1984); Ranger and Peppas, 1983, J., Macromol. Sci. Rev. Macromol. Chem. 23:61; see also Levy et al., 1985, Science 228:190; During et al., 1989, Ann. Neurol. 25:351; Howard et al., 1989, J. Neurosurg. 71:105; U.S. Patent No. 5,679,377; U.S. Patent No. 5,916,597; U.S. Patent No. 5,912,015; U.S. Patent No. 5,989,463; U.S. Patent No. 5,128,326; PCT Publication No. WO 99/15154; and PCT Publication No. WO 99/20253. Examples of polymers used in sustained release formulations include, but are not limited to, poly(2-hydroxy ethyl methacrylate), poly(methyl methacrylate), poly(acrylic acid), poly(ethylene-co-vinyl acetate), poly(methacrylic acid), polyglycolides (PLG), polyanhydrides, poly(N-vinyl pyrrolidone), poly(vinyl alcohol), polyacrylamide, poly(ethylene glycol), polylactides (PLA), poly(lactide-co-glycolides) (PLGA), and polyorthoesters. In a preferred embodiment, the polymer used in a sustained release formulation is inert, free of leachable impurities, stable on storage, sterile, and biodegradable. In yet another embodiment, a controlled or sustained release system can be placed in proximity of the therapeutic target, *i.e.*, the lungs, thus requiring only a fraction of the systemic dose (see, *e.g.*, Goodson, in Medical Applications of Controlled Release, *supra*, vol. 2, pp. 115-138 (1984)).

Controlled release systems are discussed in the review by Langer (1990, Science 249:1527-1533). Any technique known to one of skill in the art can be used to produce sustained release formulations comprising one or more antibodies or antigen-binding fragments thereof. See, *e.g.*, U.S. Patent No. 4,526,938, PCT publication WO 91/05548, PCT publication WO 96/20698, Ning *et al.*, 1996, "Intratumoral Radioimmunotherapy of a Human Colon Cancer Xenograft Using a Sustained-Release Gel," Radiotherapy & Oncology 39:179-189, Song *et al.*, 1995, "Antibody Mediated Lung Targeting of Long-Circulating Emulsions," PDA Journal of Pharmaceutical Science & Technology 50:372-397, Cleek *et al.*, 1997, "Biodegradable Polymeric Carriers for a bFGF Antibody for Cardiovascular Application," Pro. Int'l. Symp. Control. Rel. Bioact. Mater. 24:853-854, and Lam *et al.*, 1997, "Microencapsulation of Recombinant Humanized Monoclonal Antibody for Local Delivery," Proc. Int'l. Symp. Control Rel. Bioact. Mater. 24:759-760, each of which is incorporated herein by reference in their entireties.

In certain embodiments the antibodies are administered repeatedly, wherein the administrations are separated by at least 10 days, 15 days, 30 days, 2 months, 3 months or at least 6 months. In certain embodiments the antibodies are administered repeatedly, wherein

the administrations are separated by at most 10 days, 15 days, 30 days, 2 months, 3 months or at most 6 months.

In certain embodiments, the antibodies are administered during the season of increased risk of pulmonary infections. In specific embodiments, the antibodies are administered during the RSV season.

4.4 PHARMACEUTICAL COMPOSITIONS

The present invention also provides pharmaceutical compositions. Such compositions comprise one or more of the following: (i) one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof and one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof; (ii) one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof and one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof; or (iii) one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof, one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof. In certain embodiments, the pharmaceutical composition further comprises a pharmaceutically acceptable carrier. In a specific embodiment, the term "pharmaceutically acceptable" means approved by a regulatory agency of the Federal or a state government or listed in the U.S. Pharmacopeia or other generally recognized pharmacopeia for use in animals, and more particularly in humans. The term "carrier" refers to a diluent, adjuvant (*e.g.*, Freund's adjuvant (complete and incomplete)), excipient, or vehicle with which the therapeutic is administered. Such pharmaceutical carriers can be sterile liquids, such as water and oils, including those of petroleum, animal, vegetable or synthetic origin, such as peanut oil, soybean oil, mineral oil, sesame oil and the like. Water is a preferred carrier when the pharmaceutical composition is administered intravenously. Saline solutions and aqueous dextrose and glycerol solutions can also be employed as liquid carriers, particularly for injectable solutions. Suitable pharmaceutical excipients include starch, glucose, lactose, sucrose, gelatin, malt, rice, flour, chalk, silica gel, sodium stearate, glycerol monostearate, talc, sodium chloride, dried skim milk, glycerol, propylene, glycol, water, ethanol and the like. The composition, if desired, can also contain minor amounts of wetting or emulsifying agents, or pH buffering agents. These compositions can take the form of solutions, suspensions, emulsion, tablets, pills, capsules, powders, sustained-release formulations and the like. Oral formulation can include standard carriers such as pharmaceutical grades of mannitol, lactose, starch, magnesium stearate, sodium saccharine, cellulose, magnesium

carbonate, etc. Examples of suitable pharmaceutical carriers are described in "Remington's Pharmaceutical Sciences" by E.W. Martin. Such compositions will contain a prophylactically or therapeutically effective amount of the antibody or fragment thereof, preferably in purified form, together with a suitable amount of carrier so as to provide the form for proper administration to the patient. The formulation should suit the mode of administration.

In a specific embodiment, the compositions of the invention may be those disclosed in U.S. Provisional Patent Application No.: 60/388,920, filed on June 14, 2002 or 60/388,921, filed on June 14, 2002, which are incorporated by reference herein in their entireties.

In a preferred embodiment, the composition is formulated in accordance with routine procedures as a pharmaceutical composition adapted for intravenous administration to human beings. Typically, compositions for intravenous administration are solutions in sterile isotonic aqueous buffer. Where necessary, the composition may also include a solubilizing agent and a local anesthetic such as lignocaine to ease pain at the site of the injection.

Generally, the ingredients of compositions of the invention are supplied either separately or mixed together in unit dosage form, for example, as a dry lyophilized powder or water free concentrate in a hermetically sealed container such as an ampoule or sachette indicating the quantity of active agent. Where the composition is to be administered by infusion, it can be dispensed with an infusion bottle containing sterile pharmaceutical grade water or saline. Where the composition is administered by injection, an ampoule of sterile water for injection or saline can be provided so that the ingredients may be mixed prior to administration.

The compositions of the invention can be formulated as neutral or salt forms. Pharmaceutically acceptable salts include those formed with anions such as those derived from hydrochloric, phosphoric, acetic, oxalic, tartaric acids, etc., and those formed with cations such as those derived from sodium, potassium, ammonium, calcium, ferric hydroxides, isopropylamine, triethylamine, 2-ethylamino ethanol, histidine, procaine, etc.

The amount of the composition of the invention which will be effective in the treatment, prevention or amelioration of one or more symptoms associated with a respiratory viral infection can be determined by standard clinical techniques. For example, the dosage of the composition which will be effective in the treatment, prevention or amelioration of one or more symptoms associated with a respiratory viral infection can be determined by administering the composition to a cotton rat, measuring the RSV, PIV, and/or hMPV titer

after challenging the cotton rat with 10^5 pfu of RSV, PIV, and/or hMPV, respectively, and comparing the RSV, PIV, and/or hMPV titer, respectively, to that obtain for a cotton rat not administered the composition. Accordingly, a dosage that results in a 1 log decrease or a 90% reduction in RSV, PIV, and/or hMPV titer in the cotton rat challenged with 10^5 pfu of RSV, PIV, and/or hMPV, respectively, relative to the cotton rat challenged with 10^5 pfu of RSV, PIV, and/or hMPV, respectively, but not administered the composition is the dosage of the composition that can be administered to a human for the treatment, prevention or amelioration of symptoms associated with RSV infection. The dosage of the composition which will be effective in the treatment, prevention or amelioration of one or more symptoms associated with a respiratory, viral infection can be determined by administering the composition to an animal model (*e.g.*, a cotton rat or monkey) and measuring the serum titer of antibodies or antigen-binding fragments thereof that immunospecifically bind to a RSV, PIV, and/or hMPV antigen. Accordingly, a dosage of the composition that results in a serum titer of at least 1 $\mu\text{g/ml}$, preferably 2 $\mu\text{g/ml}$, 5 $\mu\text{g/ml}$, 10 $\mu\text{g/ml}$, 20 $\mu\text{g/ml}$, 25 $\mu\text{g/ml}$, at least 35 $\mu\text{g/ml}$, at least 40 $\mu\text{g/ml}$, at least 50 $\mu\text{g/ml}$, at least 75 $\mu\text{g/ml}$, at least 100 $\mu\text{g/ml}$, at least 125 $\mu\text{g/ml}$, at least 150 $\mu\text{g/ml}$, at least 200 $\mu\text{g/ml}$, at least 250 $\mu\text{g/ml}$, at least 300 $\mu\text{g/ml}$, at least 350 $\mu\text{g/ml}$, at least 400 $\mu\text{g/ml}$, or at least 450 $\mu\text{g/ml}$ for one or all of the antibodies in the composition can be administered to a human for the treatment, prevention or amelioration of one or more symptoms associated with respiratory viral infection. In addition, *in vitro* assays may optionally be employed to help identify optimal dosage ranges.

The precise dose to be employed in the formulation will also depend on the route of administration, and the seriousness of the respiratory viral infection, and should be decided according to the judgment of the practitioner and each patient's circumstances. Effective doses may be extrapolated from dose-response curves derived from *in vitro* or animal model (*e.g.*, the cotton rat or Cynomolgous monkey) test systems.

For antibodies, the dosage administered to a patient is typically 0.1 mg/kg to 100 mg/kg of each antibody per the patient's body weight. Preferably, the dosage administered to a patient is between 0.1 mg/kg and 20 mg/kg of each antibody per patient's body weight, more preferably 1 mg/kg to 10 mg/kg of each antibody per the patient's body weight. Generally, human antibodies have a longer half-life within the human body than antibodies from other species due to the immune response to the foreign polypeptides. Thus, lower dosages of human antibodies and less frequent administration is often possible. Further, the dosage and frequency of administration of antibodies of the invention or fragments thereof

may be reduced by enhancing uptake and tissue penetration (*e.g.*, into the lung) of the antibodies by modifications such as, for example, lipidation.

In a specific embodiment, antibodies of the invention or fragments thereof, or compositions comprising antibodies of the invention or fragments thereof are administered once a month, once every 6 weeks, or once every 2 months just prior to or during the RSV season. In a specific embodiment, antibodies of the invention or fragments thereof, or compositions comprising antibodies of the invention or fragments thereof are administered once a month, once every 6 weeks, or once every 2 months just prior to or during the PIV season. In a specific embodiment, antibodies of the invention or fragments thereof, or compositions comprising antibodies of the invention or fragments thereof are administered once a month, once every 6 weeks, or once every 2 months just prior to or during the hMPV season. In another embodiment, antibodies or antigen-binding fragments thereof, or compositions comprising antibodies or antigen-binding fragments thereof are administered every two months just prior to or during the RSV, PIV, or hMPV season. In yet another embodiment, antibodies or antigen-binding fragments thereof, or compositions comprising antibodies or antigen-binding fragments thereof are administered once just prior to or during the RSV, PIV, or hMPV season. The term "RSV season" refers to the season when RSV infection is most likely to occur. Typically, the RSV season in the northern hemisphere commences in November and lasts through April.

In certain embodiments, the antibodies are administered at least 1 time, 2 times, 3 times, 4 times, 5 times, 6 times, 7 times, 8 times, 9 times, 10 times, 15 times or at least 20 times per RSV season. In certain embodiments, the antibodies are administered at most 1 time, 2 times, 3 times, 4 times, 5 times, 6 times, 7 times, 8 times, 9 times, 10 times, 15 times or at most 20 times per RSV season. In certain embodiments, the antibodies are administered at least 1 time, 2 times, 3 times, 4 times, 5 times, 6 times, 7 times, 8 times, 9 times, 10 times, 15 times or at least 20 times per PIV season. In certain embodiments, the antibodies are administered at most 1 time, 2 times, 3 times, 4 times, 5 times, 6 times, 7 times, 8 times, 9 times, 10 times, 15 times or at most 20 times per PIV season. In certain embodiments, the antibodies are administered at least 1 time, 2 times, 3 times, 4 times, 5 times, 6 times, 7 times, 8 times, 9 times, 10 times, 15 times or at least 20 times per hMPV season. In certain embodiments, the antibodies are administered at most 1 time, 2 times, 3 times, 4 times, 5 times, 6 times, 7 times, 8 times, 9 times, 10 times, 15 times or at most 20 times per hMPV season.

4.5 GENE THERAPY

In a specific embodiment, nucleic acids comprising sequences encoding antibodies that immunospecifically bind to an RSV antigen, a PIV antigen, and/or a hMPV antigen or functional derivatives thereof, are administered to treat, prevent or ameliorate one or more symptoms associated with RSV infection, by way of gene therapy. Gene therapy refers to therapy performed by the administration to a subject of an expressed or expressible nucleic acid. In this embodiment of the invention, the nucleic acids produce their encoded antibody or antibody fragment that mediates a prophylactic or therapeutic effect. In a specific embodiment, intrabodies are delivered to a subject via gene therapy (see section 4.1).

Any of the methods for gene therapy available in the art can be used according to the present invention. Exemplary methods are described below.

For general reviews of the methods of gene therapy, see Goldspiel et al., 1993, *Clinical Pharmacy* 12:488-505; Wu and Wu, 1991, *Biotherapy* 3:87-95; Tolstoshev, 1993, *Ann. Rev. Pharmacol. Toxicol.* 32:573-596; Mulligan, *Science* 260:926-932 (1993); and Morgan and Anderson, 1993, *Ann. Rev. Biochem.* 62:191-217; May, 1993, *TIBTECH* 11(5):155-215. Methods commonly known in the art of recombinant DNA technology which can be used are described in Ausubel et al. (eds.), *Current Protocols in Molecular Biology*, John Wiley & Sons, NY (1993); and Kriegler, *Gene Transfer and Expression, A Laboratory Manual*, Stockton Press, NY (1990).

In a preferred aspect, a composition of the invention comprises nucleic acids encoding an antibody, said nucleic acids being part of an expression vector that expresses the antibody or fragments or chimeric proteins or heavy or light chains thereof in a suitable host. In particular, such nucleic acids have promoters, preferably heterologous promoters, operably linked to the antibody coding region, said promoter being inducible or constitutive, and, optionally, tissue- specific. In another particular embodiment, nucleic acid molecules are used in which the antibody coding sequences and any other desired sequences are flanked by regions that promote homologous recombination at a desired site in the genome, thus providing for intrachromosomal expression of the antibody encoding nucleic acids (Koller and Smithies, 1989, *Proc. Natl. Acad. Sci. USA* 86:8932-8935; Zijlstra et al., 1989, *Nature* 342:435-438). In specific embodiments, the expressed antibody molecule is a single chain antibody; alternatively, the nucleic acid sequences include sequences encoding both the heavy and light chains, or fragments thereof, of the antibody.

Delivery of the nucleic acids into a subject may be either direct, in which case the subject is directly exposed to the nucleic acid or nucleic acid-carrying vectors, or indirect, in which case, cells are first transformed with the nucleic acids *in vitro*, then transplanted into the subject. These two approaches are known, respectively, as *in vivo* or *ex vivo* gene therapy.

In a specific embodiment, the nucleic acid sequences are directly administered *in vivo*, where it is expressed to produce the encoded product. This can be accomplished by any of numerous methods known in the art, *e.g.*, by constructing them as part of an appropriate nucleic acid expression vector and administering it so that they become intracellular, *e.g.*, by infection using defective or attenuated retrovirals or other viral vectors (see U.S. Patent No. 4,980,286), or by direct injection of naked DNA, or by use of microparticle bombardment (*e.g.*, a gene gun; Biolistic, Dupont), or coating with lipids or cell-surface receptors or transfecting agents, encapsulation in liposomes, microparticles, or microcapsules, or by administering them in linkage to a peptide which is known to enter the nucleus, by administering it in linkage to a ligand subject to receptor-mediated endocytosis (see, *e.g.*, Wu and Wu, 1987, J. Biol. Chem. 262:4429-4432) (which can be used to target cell types specifically expressing the receptors), etc. In another embodiment, nucleic acid-ligand complexes can be formed in which the ligand comprises a fusogenic viral peptide to disrupt endosomes, allowing the nucleic acid to avoid lysosomal degradation. In yet another embodiment, the nucleic acid can be targeted *in vivo* for cell specific uptake and expression, by targeting a specific receptor (see, *e.g.*, PCT Publications WO 92/06180; WO 92/22635; W092/203 16; W093/14188, WO 93/20221). Alternatively, the nucleic acid can be introduced intracellularly and incorporated within host cell DNA for expression, by homologous recombination (Koller and Smithies, 1989, Proc. Natl. Acad. Sci. USA 86:8932-8935; and Zijlstra et al., 1989, Nature 342:435-438).

In a specific embodiment, viral vectors that contains nucleic acid sequences encoding an antibody of the invention or fragments thereof are used. For example, a retroviral vector can be used (see Miller et al., 1993, Meth. Enzymol. 217:581-599). These retroviral vectors contain the components necessary for the correct packaging of the viral genome and integration into the host cell DNA. The nucleic acid sequences encoding the antibody to be used in gene therapy are cloned into one or more vectors, which facilitates delivery of the gene into a subject. More detail about retroviral vectors can be found in Boesen et al., 1994, Biotherapy 6:291-302, which describes the use of a retroviral vector to deliver the *mdr 1* gene

to hematopoietic stem cells in order to make the stem cells more resistant to chemotherapy. Other references illustrating the use of retroviral vectors in gene therapy are: Clowes et al., 1994, J. Clin. Invest. 93:644-651; Klein et al., 1994, Blood 83:1467-1473; Salmons and Gunzberg, 1993, Human Gene Therapy 4:129-141; and Grossman and Wilson, 1993, Curr. Opin. in Genetics and Devel. 3:110-114.

Adenoviruses are other viral vectors that can be used in gene therapy. Adenoviruses are especially attractive vehicles for delivering genes to respiratory epithelia. Adenoviruses naturally infect respiratory epithelia where they cause a mild disease. Other targets for adenovirus-based delivery systems are liver, the central nervous system, endothelial cells, and muscle. Adenoviruses have the advantage of being capable of infecting non-dividing cells. Kozarsky and Wilson, 1993, Current Opinion in Genetics and Development 3:499-503 present a review of adenovirus-based gene therapy. Bout et al., 1994, Human Gene Therapy 5:3-10 demonstrated the use of adenovirus vectors to transfer genes to the respiratory epithelia of rhesus monkeys. Other instances of the use of adenoviruses in gene therapy can be found in Rosenfeld et al., 1991, Science 252:431-434; Rosenfeld et al., 1992, Cell 68:143-155; Mastrangeli et al., 1993, J. Clin. Invest. 91:225-234; PCT Publication W094/12649; and Wang et al., 1995, Gene Therapy 2:775-783. In a preferred embodiment, adenovirus vectors are used.

Adeno-associated virus (AAV) has also been proposed for use in gene therapy (Walsh et al., 1993, Proc. Soc. Exp. Biol. Med. 204:289-300; and U.S. Patent No. 5,436,146).

Another approach to gene therapy involves transferring a gene to cells in tissue culture by such methods as electroporation, lipofection, calcium phosphate mediated transfection, or viral infection. Usually, the method of transfer includes the transfer of a selectable marker to the cells. The cells are then placed under selection to isolate those cells that have taken up and are expressing the transferred gene. Those cells are then delivered to a subject.

In this embodiment, the nucleic acid is introduced into a cell prior to administration *in vivo* of the resulting recombinant cell. Such introduction can be carried out by any method known in the art, including but not limited to transfection, electroporation, microinjection, infection with a viral or bacteriophage vector containing the nucleic acid sequences, cell fusion, chromosome-mediated gene transfer, microcell-mediated gene transfer, spheroplast fusion, etc. Numerous techniques are known in the art for the introduction of foreign genes into cells (see, *e.g.*, Loeffler and Behr, 1993, Meth. Enzymol. 217:599-618; Cohen et al.,

1993, Meth. Enzymol. 217:618-644; Clin. Pharma. Ther. 29:69-92 (1985)) and may be used in accordance with the present invention, provided that the necessary developmental and physiological functions of the recipient cells are not disrupted. The technique should provide for the stable transfer of the nucleic acid to the cell, so that the nucleic acid is expressible by the cell and preferably heritable and expressible by its cell progeny.

The resulting recombinant cells can be delivered to a subject by various methods known in the art. Recombinant blood cells (*e.g.*, hematopoietic stem or progenitor cells) are preferably administered intravenously. The amount of cells envisioned for use depends on the desired effect, patient state, etc., and can be determined by one skilled in the art.

Cells into which a nucleic acid can be introduced for purposes of gene therapy encompass any desired, available cell type, and include but are not limited to epithelial cells, endothelial cells, keratinocytes, fibroblasts, muscle cells, hepatocytes; blood cells such as T lymphocytes, B lymphocytes, monocytes, macrophages, neutrophils, eosinophils, megakaryocytes, granulocytes; various stem or progenitor cells, in particular hematopoietic stem or progenitor cells, *e.g.*, as obtained from bone marrow, umbilical cord blood, peripheral blood, fetal liver, etc.

In a preferred embodiment, the cell used for gene therapy is autologous to the subject.

In an embodiment in which recombinant cells are used in gene therapy, nucleic acid sequences encoding an antibody or fragment thereof are introduced into the cells such that they are expressible by the cells or their progeny, and the recombinant cells are then administered *in vivo* for therapeutic effect. In a specific embodiment, stem or progenitor cells are used. Any stem and/or progenitor cells which can be isolated and maintained *in vitro* can potentially be used in accordance with this embodiment of the present invention (see *e.g.*, PCT Publication WO 94/08598; Stemple and Anderson, 1992, Cell 71:973-985; Rheinwald, 1980, Meth. Cell Bio. 21A:229; and Pittelkow and Scott, 1986, Mayo Clinic Proc. 61:771).

In a specific embodiment, the nucleic acid to be introduced for purposes of gene therapy comprises an inducible promoter operably linked to the coding region, such that expression of the nucleic acid is controllable by controlling the presence or absence of the appropriate inducer of transcription.

4.6 ANTIBODY CHARACTERIZATION AND DEMONSTRATION OF THERAPEUTIC OR PROPHYLACTIC UTILITY

Antibodies may be characterized in a variety of ways. In particular, antibodies may be assayed for the ability to immunospecifically bind to a RSV antigen, a PIV antigen, and/or a hMPV antigen. Such an assay may be performed in solution (*e.g.*, Houghten, 1992, *Bio/Techniques* 13:412-421), on beads (Lam, 1991, *Nature* 354:82-84), on chips (Fodor, 1993, *Nature* 364:555-556), on bacteria (U.S. Patent No. 5,223,409), on spores (U.S. Patent Nos. 5,571,698; 5,403,484; and 5,223,409), on plasmids (Cull et al., 1992, *Proc. Natl. Acad. Sci. USA* 89:1865-1869) or on phage (Scott and Smith, 1990, *Science* 249:386-390; Devlin, 1990, *Science* 249:404-406; Cwirla et al., 1990, *Proc. Natl. Acad. Sci. USA* 87:6378-6382; and Felici, 1991, *J. Mol. Biol.* 222:301-310) (each of these references is incorporated herein in its entirety by reference). Antibodies or antigen-binding fragments thereof that have been identified to immunospecifically bind to a RSV antigen, a PIV antigen, and/or a hMPV antigen or a fragment thereof can then be assayed for their avidity and affinity for a RSV antigen, a PIV antigen, and/or a hMPV antigen.

Immunospecific binding and cross-reactivity with other antigens of an antibody may be determined by any method known in the art. Immunoassays which can be used to analyze immunospecific binding and cross-reactivity include, but are not limited to, competitive and non-competitive assay systems using techniques such as western blots, radioimmunoassays, ELISA (enzyme linked immunosorbent assay), "sandwich" immunoassays, immunoprecipitation assays, precipitin reactions, gel diffusion precipitin reactions, immunodiffusion assays, agglutination assays, complement-fixation assays, immunoradiometric assays, fluorescent immunoassays, protein A immunoassays, to name but a few. Such assays are routine and well known in the art (see, *e.g.*, Ausubel et al, eds, 1994, *Current Protocols in Molecular Biology*, Vol. 1, John Wiley & Sons, Inc., New York, which is incorporated by reference herein in its entirety). Exemplary immunoassays are described briefly below (but are not intended by way of limitation).

Immunoprecipitation protocols generally comprise lysing a population of cells in a lysis buffer such as RIPA buffer (1% NP-40 or Triton X-100, 1% sodium deoxycholate, 0.1% SDS, 0.15 M NaCl, 0.01 M sodium phosphate at pH 7.2, 1% Trasylol) supplemented with protein phosphatase and/or protease inhibitors (*e.g.*, EDTA, PMSF, aprotinin, sodium vanadate), adding the antibody of interest to the cell lysate, incubating for a period of time (*e.g.*, 1 to 4 hours) at 40° C, adding protein A and/or protein G sepharose beads to the cell lysate, incubating for about an hour or more at 40° C, washing the beads in lysis buffer and resuspending the beads in SDS/sample buffer. The ability of the antibody of interest to

immunoprecipitate a particular antigen can be assessed by, *e.g.*, western blot analysis. One of skill in the art would be knowledgeable as to the parameters that can be modified to increase the binding of the antibody to an antigen and decrease the background (*e.g.*, pre-clearing the cell lysate with sepharose beads). For further discussion regarding immunoprecipitation protocols see, *e.g.*, Ausubel et al, eds, 1994, Current Protocols in Molecular Biology, Vol. 1, John Wiley & Sons, Inc., New York at 10.16.1.

Western blot analysis generally comprises preparing protein samples, electrophoresis of the protein samples in a polyacrylamide gel (*e.g.*, 8%- 20% SDS-PAGE depending on the molecular weight of the antigen), transferring the protein sample from the polyacrylamide gel to a membrane such as nitrocellulose, PVDF or nylon, blocking the membrane in blocking solution (*e.g.*, PBS with 3% BSA or non-fat milk), washing the membrane in washing buffer (*e.g.*, PBS-Tween 20), blocking the membrane with primary antibody (the antibody of interest) diluted in blocking buffer, washing the membrane in washing buffer, blocking the membrane with a secondary antibody (which recognizes the primary antibody, *e.g.*, an anti-human antibody) conjugated to an enzymatic substrate (*e.g.*, horseradish peroxidase or alkaline phosphatase) or radioactive molecule (*e.g.*, ^{32}P or ^{125}I) diluted in blocking buffer, washing the membrane in wash buffer, and detecting the presence of the antigen. One of skill in the art would be knowledgeable as to the parameters that can be modified to increase the signal detected and to reduce the background noise. For further discussion regarding western blot protocols see, *e.g.*, Ausubel et al, eds, 1994, Current Protocols in Molecular Biology, Vol. 1, John Wiley & Sons, Inc., New York at 10.8.1.

ELISAs comprise preparing antigen, coating the well of a 96 well microtiter plate with the antigen, adding the antibody of interest conjugated to a detectable compound such as an enzymatic substrate (*e.g.*, horseradish peroxidase or alkaline phosphatase) to the well and incubating for a period of time, and detecting the presence of the antigen. In ELISAs the antibody of interest does not have to be conjugated to a detectable compound; instead, a second antibody (which recognizes the antibody of interest) conjugated to a detectable compound may be added to the well. Further, instead of coating the well with the antigen, the antibody may be coated to the well. In this case, a second antibody conjugated to a detectable compound may be added following the addition of the antigen of interest to the coated well. One of skill in the art would be knowledgeable as to the parameters that can be modified to increase the signal detected as well as other variations of ELISAs known in the

art. For further discussion regarding ELISAs see, *e.g.*, Ausubel et al, eds, 1994, Current Protocols in Molecular Biology, Vol. 1, John Wiley & Sons, Inc., New York at 11.2.1.

The binding affinity of an antibody to an antigen and the off-rate of an antibody-antigen interaction can be determined by competitive binding assays. One example of a competitive binding assay is a radioimmunoassay comprising the incubation of labeled antigen (*e.g.*, ^3H or ^{125}I) with the antibody of interest in the presence of increasing amounts of unlabeled antigen, and the detection of the antibody bound to the labeled antigen. The affinity of the antibody of the present invention or a fragment thereof for a RSV antigen and the binding off-rates can be determined from the data by scatchard plot analysis. Competition with a second antibody can also be determined using radioimmunoassays. In a specific embodiment, a first antibody or an antigen-binding fragment thereof is conjugated to a labeled compound (*e.g.*, ^3H or ^{125}I) in the presence of increasing amounts of an unlabeled second antibody.

In a preferred embodiment, BIAcore kinetic analysis is used to determine the binding on and off rates of antibodies or antigen-binding fragments thereof to a RSV, PIV and/or hMPV antigen. BIAcore kinetic analysis comprises analyzing the binding and dissociation of a RSV antigen from chips with immobilized antibodies or antigen-binding fragments thereof on their surface (see the Example section *infra*).

The antibodies of the invention or fragments thereof can also be assayed for their ability to inhibit the binding of RSV, PIV and/or hMPV to its host cell receptor using techniques known to those of skill in the art. For example, cells expressing the receptor for RSV, PIV and/or hMPV, respectively, can be contacted with RSV, PIV and/or hMPV, respectively, in the presence or absence of an antibody or fragment thereof and the ability of the antibody or fragment thereof to inhibit RSV, PIV and/or hMPV's binding can be measured by, for example, flow cytometry or a scintillation assay. RSV, PIV and/or hMPV (*e.g.*, a RSV, PIV and/or hMPV antigen such as F glycoprotein or G glycoprotein) or the antibody or antibody fragment can be labeled with a detectable compound such as a radioactive label (*e.g.*, ^{32}P , ^{35}S , and ^{125}I) or a fluorescent label (*e.g.*, fluorescein isothiocyanate, rhodamine, phycoerythrin, phycocyanin, allophycocyanin, *o*-phthaldehyde and fluorescamine) to enable detection of an interaction between RSV, PIV and/or hMPV and its respective host cell receptor. Alternatively, the ability of antibodies or antigen-binding fragments thereof to inhibit RSV, PIV and/or hMPV from binding to its receptor can be determined in cell-free assays. For example, RSV, PIV and/or hMPV or a RSV, PIV and/or hMPV antigen such as

G glycoprotein can be contacted with an antibody or fragment thereof and the ability of the antibody or antibody fragment to inhibit RSV, PIV and/or hMPV or the RSV, PIV and/or hMPV antigen from binding to its host cell receptor can be determined. Preferably, the antibody or the antibody fragment is immobilized on a solid support and RSV, PIV and/or hMPV, or a RSV, PIV and/or hMPV antigen is labeled with a detectable compound. Alternatively, RSV, PIV and/or hMPV, or a RSV, PIV and/or hMPV antigen is immobilized on a solid support and the antibody or fragment thereof is labeled with a detectable compound. RSV, PIV and/or hMPV, or a RSV, PIV and/or hMPV antigen may be partially or completely purified (*e.g.*, partially or completely free of other polypeptides) or part of a cell lysate. Further, a RSV, PIV and/or hMPV antigen may be a fusion protein comprising the RSV, PIV and/or hMPV antigen and a domain such as glutathione-S-transferase. Alternatively, a RSV, PIV and/or hMPV antigen can be biotinylated using techniques well known to those of skill in the art (*e.g.*, biotinylation kit, Pierce Chemicals; Rockford, IL).

The antibodies of the invention or fragments thereof can also be assayed for their ability to inhibit or downregulate RSV, PIV and/or hMPV replication using techniques known to those of skill in the art. For example, RSV, PIV and/or hMPV replication can be assayed by a plaque assay such as described, *e.g.*, by Johnson et al., 1997, Journal of Infectious Diseases 176:1215-1224. The antibodies of the invention or fragments thereof can also be assayed for their ability to inhibit or downregulate the expression of RSV, PIV and/or hMPV polypeptides. Techniques known to those of skill in the art, including, but not limited to, Western blot analysis, Northern blot analysis, and RT-PCR can be used to measure the expression of RSV, PIV and/or hMPV polypeptides. Further, the antibodies of the invention or fragments thereof can be assayed for their ability to prevent the formation of syncytia.

The antibodies of the invention or fragments thereof are preferably tested *in vitro*, and then *in vivo* for the desired therapeutic or prophylactic activity, prior to use in humans. For example, *in vitro* assays which can be used to determine whether administration of a specific antibody or composition of the present invention is indicated, include *in vitro* cell culture assays in which a subject tissue sample is grown in culture, and exposed to or otherwise administered an antibody or composition of the present invention, and the effect of such an antibody or composition of the present invention upon the tissue sample is observed. In various specific embodiments, *in vitro* assays can be carried out with representative cells of cell types involved in a RSV, PIV and/or hMPV infection (*e.g.*, respiratory epithelial cells), to determine if an antibody or composition of the present invention has a desired effect upon

such cell types. Preferably, the antibodies or compositions comprising the antibodies are also tested in *in vitro* assays and animal model systems prior to administration to humans. In a specific embodiment, cotton rats are administered an antibody or fragment thereof, or a composition of the invention, challenged with 10^5 pfu of RSV, PIV and/or hMPV, and four or more days later the rats are sacrificed and RSV, PIV and/or hMPV titer and anti-RSV, anti-PIV and/or anti-hMPV antibody serum level is determined. Further, in accordance with this embodiment, the tissues (*e.g.*, the lung tissues) from the sacrificed rats can be examined for histological changes.

In accordance with the invention, clinical trials with human subjects need not be performed in order to demonstrate the prophylactic and/or therapeutic efficacy of antibodies of the invention or fragments thereof. *In vitro* and animal model studies using the antibodies or antigen-binding fragments thereof can be extrapolated to humans and are sufficient for demonstrating the prophylactic and/or therapeutic utility of said antibodies or antibody fragments.

Antibodies or compositions that can be used with the methods of the present invention can be tested for their toxicity in suitable animal model systems, including but not limited to rats, mice, cows, monkeys, and rabbits. For *in vivo* testing of an antibody or composition's toxicity any animal model system known in the art may be used.

The treatment is considered therapeutic if there is, for example, a reduction in viral load, amelioration of one or more symptoms, a reduction in the duration of a respiratory viral infection, or a decrease in mortality and/or morbidity following administration of an antibody or composition of the invention. Further, the treatment is considered therapeutic if there is an increase in the immune response following the administration of one or more antibodies or antigen-binding fragments thereof which immunospecifically bind to one or more RSV, PIV, and/or hMPV antigens.

Antibodies can be tested *in vitro* and *in vivo* for the ability to affect the expression levels of cytokines such as, but not limited to, IFN- α , IFN- β , IFN- γ , IL-2, IL-3, IL-4, IL-5, IL-6, IL-7, IL-8, IL-9, IL-10, IL-12 and IL-15. In a more specific embodiment, an antibody or composition of the invention is tested for its ability to affect the expression level of one or more cytokines, the expression of which have been induced by a respiratory viral infection. In an even more specific embodiment, an antibody or composition of the invention is tested for its ability to reduce the expression level of one or more virus-induced cytokines.

Techniques known to those of skill in the art can be used to measure the level of expression

of cytokines. For example, the level of expression of cytokines can be measured by analyzing the level of RNA of cytokines by, for example, RT-PCR and Northern blot analysis, and by analyzing the level of cytokines by, for example, immunoprecipitation followed by western blot analysis and ELISA. In a preferred embodiment, an antibody or composition of the invention is tested for its ability to affect the expression of IFN- γ . In a more specific embodiment, an antibody or composition of the invention is tested for its ability to affect the expression level of IFN- γ the expression of which has been induced by a respiratory viral infection. In an even more specific embodiment, an antibody or composition of the invention is tested for its ability to reduce the expression level of virus-induced IFN- γ .

Antibodies can be tested *in vitro* and *in vivo* for their ability to modulate the biological activity of immune cells, preferably human immune cells (*e.g.*, but not limited to, T-cells, B-cells, and Natural Killer cells). In more specific embodiments, antibodies can be tested *in vitro* and *in vivo* for their ability to modulate the biological activity of immune cells that has been induced by a respiratory viral infection. In even more specific embodiments, antibodies can be tested for their ability to reduce the one or more biological activities of immune cells that have been induced by a respiratory viral infection. The ability of antibodies or antigen-binding fragments thereof to modulate the biological activity of immune cells can be assessed by detecting the expression of antigens, detecting the proliferation of immune cells, detecting the activation of signaling molecules, detecting the effector function of immune cells, or detecting the differentiation of immune cells.

Techniques known to those of skill in the art can be used for measuring these activities. For example, cellular proliferation can be assayed by ³H-thymidine incorporation assays and trypan blue cell counts. Antigen expression can be assayed, for example, by immunoassays including, but are not limited to, competitive and non-competitive assay systems using techniques such as western blots, immunohistochemistry radioimmunoassays, ELISA (enzyme linked immunosorbent assay), "sandwich" immunoassays, immunoprecipitation assays, precipitin reactions, gel diffusion precipitin reactions, immunodiffusion assays, agglutination assays, complement-fixation assays, immunoradiometric assays, fluorescent immunoassays, protein A immunoassays and FACS analysis. The activation of signaling molecules can be assayed, for example, by kinase assays and electrophoretic shift assays (EMSAs).

Antibodies can also be tested for their ability to inhibit viral replication or reduce viral load in *in vitro*, *ex vivo* and *in vivo* assays. Antibodies can also be tested for their ability to

decrease the time course of a respiratory viral infection. Antibodies can also be tested for their ability to increase the survival period of humans suffering from RSV infection by at least 25%, preferably at least 50%, at least 60%, at least 75%, at least 85%, at least 95%, or at least 99%. Further, antibodies can be tested for their ability reduce the hospitalization period of humans suffering from respiratory viral infection by at least 60%, preferably at least 75%, at least 85%, at least 95%, or at least 99%. Techniques known to those of skill in the art can be used to analyze the function of the antibodies or compositions of the invention *in vivo*.

4.7 KITS

The invention also provides a pharmaceutical pack or kit comprising one or more containers filled with one or more of the ingredients of the pharmaceutical compositions of the invention. Optionally associated with such container(s) can be a notice in the form prescribed by a governmental agency regulating the manufacture, use or sale of pharmaceuticals or biological products, which notice reflects approval by the agency of manufacture, use or sale for human administration.

The present invention provides kits that can be used in the above methods. In one embodiment, a kit comprises (i) one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof and one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof; (ii) one or more anti-PIV-antigen antibodies or antigen-binding fragments thereof and one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof; or (iii) one or more anti-RSV-antigen antibodies or antigen-binding fragments thereof, one or more anti-hMPV-antigen antibodies or antigen-binding fragments thereof. In certain embodiments, a kit comprises one or more anti-PIV-antigen antibodies, one or more anti-hMPV-antigen antibodies, and one or more anti-RSV-antigen antibodies.

In certain embodiments, the kits of the present invention further comprise a control antibody which does not react with a RSV antigen, a PIV antigen, and a hMPV antigen. In another specific embodiments, the kits of the present invention contain a means for detecting the binding of an antibody to a RSV antigen, a PIV antigen, and/or a hMPV antigen (*e.g.*, the antibody may be conjugated to a detectable substrate such as a fluorescent compound, an enzymatic substrate, a radioactive compound or a luminescent compound, or a second antibody which recognizes the first antibody may be conjugated to a detectable substrate). In specific embodiments, the kit may include a recombinantly produced or chemically synthesized RSV antigen, a PIV antigen, and/or a hMPV antigen. The RSV antigen, a PIV antigen, and/or a hMPV antigen provided in the kit may also be attached to a solid support.

In a more specific embodiment the detecting means of the above-described kit includes a solid support to which RSV antigen, a PIV antigen, and/or a hMPV antigen is attached. Such a kit may also include a non-attached reporter-labeled anti-human antibody. In this embodiment, binding of the antibody to the RSV antigen, a PIV antigen, and/or a hMPV antigen can be detected by binding of the said reporter-labeled antibody.

4.8. ASSAYS FOR USE WITH THE INVENTION

4.8.1 MEASUREMENT OF INCIDENCE OF INFECTION RATE

The incidence of infection can be determined by any method well-known in the art, for example, but not limited to, clinical samples (e.g., nasal swabs) can be tested for the presence of RSV, PIV, and/or hMPV by immunofluorescence assay (IFA) using an anti-RSV-antigen antibody, an anti-PIV-antigen antibody, and/or an anti-hMPV-antigen antibody, respectively. Samples containing intact cells can be directly processed, whereas isolates without intact cells should first be cultured on a permissive cell line (e.g. HEP-2 cells). Cultured cell suspensions should be cleared by centrifugation at, e.g., 300xg for 5 minutes at room temperature, followed by a PBS, pH 7.4 (Ca⁺⁺ and Mg⁺⁺ free) wash under the same conditions. Cell pellets are resuspended in a small volume of PBS for analysis. Primary clinical isolates containing intact cells are mixed with PBS and centrifuged at 300xg for 5 minutes at room temperature. Mucus is removed from the interface with a sterile pipette tip and cell pellets are washed once more with PBS under the same conditions. Pellets are then resuspended in a small volume of PBS for analysis. Five to ten microliters of each cell suspension are spotted per 5 mm well on acetone washed 12-well HTC supercured glass slides and allowed to air dry. Slides are fixed in cold (-20°C) acetone for 10 minutes. Reactions are blocked by adding PBS - 1% BSA to each well followed by a 10 minute incubation at room temperature. Slides are washed three times in PBS - 0.1% Tween-20 and air dried. Ten microliters of each primary antibody reagent diluted to 250 ng/ml in blocking buffer is spotted per well and reactions are incubated in a humidified 37°C environment for 30 minutes. Slides are then washed extensively in three changes of PBS - 0.1% Tween-20 and air dried. Ten microliters of appropriate secondary conjugated antibody reagent diluted to 250 ng/ml in blocking buffer are spotted per respective well and reactions are incubated in a humidified 37°C environment for an additional 30 minutes. Slides are then washed in three changes of PBS - 0.1% Tween-20. Five microliters of PBS-50% glycerol-10 mM Tris pH 8.0-1 mM EDTA are spotted per reaction well, and slides are mounted with cover slips. Each

reaction well is subsequently analyzed by fluorescence microscopy at 200X power using a B-2A filter (EX 450-490 nm). Positive reactions are scored against an autofluorescent background obtained from unstained cells or cells stained with secondary reagent alone. RSV positive reactions are characterized by bright fluorescence punctuated with small inclusions in the cytoplasm of infected cells.

4.8.2 MEASUREMENT OF SERUM TITER

The antibody serum titer can be determined by any method well-known in the art, for example, but not limited to, the amount of antibody or antibody fragment in serum samples can be quantitated by a sandwich ELISA. Briefly, the ELISA consists of coating microtiter plates overnight at 4°C with an antibody that recognizes the antibody or antibody fragment in the serum. The plates are then blocked for approximately 30 minutes at room temperature with PBS-Tween-0.5% BSA. Standard curves are constructed using purified antibody or antibody fragment diluted in PBS-TWEEN-BSA, and samples are diluted in PBS-BSA-BSA. The samples and standards are added to duplicate wells of the assay plate and are incubated for approximately 1 hour at room temperature. Next, the non-bound antibody is washed away with PBS-TWEEN and the bound antibody is treated with a labeled secondary antibody (e.g., horseradish peroxidase conjugated goat-anti-human IgG) for approximately 1 hour at room temperature. Binding of the labeled antibody is detected by adding a chromogenic substrate specific for the label and measuring the rate of substrate turnover, e.g., by a spectrophotometer. The concentration of antibody or antibody fragment levels in the serum is determined by comparison of the rate of substrate turnover for the samples to the rate of substrate turnover for the standard curve.

4.8.3 BIACORE ASSAY

Determination of the kinetic parameters of antibody binding can be determined for example by the injection of 250 μ L of monoclonal antibody ("mAb") at varying concentration in HBS buffer containing 0.05% Tween-20 over a sensor chip surface, onto which has been immobilized the antigen. The flow rate is maintained constant at 75 μ L/min. Dissociation data is collected for 15 min, or longer as necessary. Following each injection/dissociation cycle, the bound mAb is removed from the antigen surface using brief, 1 min pulses of dilute acid, typically 10-100 mM HCl, though other regenerants are employed as the circumstances warrant.

More specifically, for measurement of the rates of association, k_{on} , and dissociation, k_{off} , the antigen is directly immobilized onto the sensor chip surface through the use of standard amine coupling chemistries, namely the EDC/NHS method (EDC= N-diethylaminopropyl)-carbodiimide). Briefly, a 5-100 nM solution of the antigen in 10 mM NaOAc, pH4 or pH5 is prepared and passed over the EDC/NHS-activated surface until approximately 30-50 RU's worth of antigen are immobilized. Following this, the unreacted active esters are "capped" off with an injection of 1M Et-NH₂. A blank surface, containing no antigen, is prepared under identical immobilization conditions for reference purposes. Once a suitable surface has been prepared, an appropriate dilution series of each one of the antibody reagents is prepared in HBS/Tween-20, and passed over both the antigen and reference cell surfaces, which are connected in series. The range of antibody concentrations that are prepared varies depending on what the equilibrium binding constant, K_D , is estimated to be. As described above, the bound antibody is removed after each injection/dissociation cycle using an appropriate regenerant.

Once an entire data set is collected, the resulting binding curves are globally fitted using algorithms supplied by the instrument manufacturer, BIAcore, Inc. (Piscataway, NJ). All data are fitted to a 1:1 Langmuir binding model. These algorithm calculate both the k_{on} and the k_{off} , from which the apparent equilibrium binding constant, K_D , is deduced as the ratio of the two rate constants (i.e. k_{off}/k_{on}). More detailed treatments of how the individual rate constants are derived can be found in the BIAevaluation Software Handbook (BIAcore, Inc., Piscataway, NJ).

4.8.4 MICRONEUTRALIZATION ASSAY

The ability of antibodies or antigen-binding fragments thereof to neutralize virus infectivity is determined by a microneutralization assay. This microneutralization assay is a modification of the procedures described by Anderson et al. (1985, J. Clin. Microbiol. 22:1050-1052, the disclosure of which is hereby incorporated by reference in its entirety). The procedure is also described in Johnson et al., 1999, J. Infectious Diseases 180:35-40, the disclosure of which is hereby incorporated by reference in its entirety.

Antibody dilutions are made in triplicate using a 96-well plate. Ten TCID₅₀ of RSV, PIV, APV, and/or hMPV are incubated with serial dilutions of the antibody or antigen-binding fragments thereof to be tested for 2 hours at 37°C in the wells of a 96-well plate. RSV susceptible cultured liver cells, such as, but not limited to HEp-2 cells (2.5×10^4) are

then added to each well and cultured for 5 days at 37_C in 5% CO₂. After 5 days, the medium is aspirated and cells are washed and fixed to the plates with 80% methanol and 20% PBS. Virus replication is then determined by viral antigen, such as F protein expression. Fixed cells are incubated with a biotin-conjugated anti-viral antigen, such as anti-F protein monoclonal antibody (*e.g.*, pan F protein, C-site-specific MAb 133-1H) washed and horseradish peroxidase conjugated avidin is added to the wells. The wells are washed again and turnover of substrate TMB (thionitrobenzoic acid) is measured at 450 nm. The neutralizing titer is expressed as the antibody concentration that causes at least 50% reduction in absorbency at 450 nm (the OD₄₅₀) from virus-only control cells.

4.8.5 VIRAL FUSION INHIBITION ASSAY

The ability of anti-RSV-antigen antibodies, anti-PIV-antigen antibodies, and/or anti-hMPV-antigen antibodies or antigen-binding fragments thereof to block RSV, PIV, and hMPV, respectively, induced fusion after viral attachment to the cells is determined in a fusion inhibition assay. This assay is identical to the microneutralization assay, except that the cells are infected with the respective virus for four hours prior to addition of antibody (Taylor et al,1992, J. Gen. Virol. 73:2217-2223).

4.8.6 ISOTHERMAL TITRATION CALORIMETRY

Thermodynamic binding affinities and enthalpies are determined from isothermal titration calorimetry (ITC) measurements on the interaction of antibodies with their respective antigen.

Antibodies are diluted in dialysate and the concentrations were determined by UV spectroscopic absorption measurements with a Perkin-Elmer Lambda 4B Spectrophotometer using an extinction coefficient of 217,000 M⁻¹ cm⁻¹ at the peak maximum at 280 nm. The diluted RSV-antigen, PIV-antigen, and/or hMPV-antigen concentrations are calculated from the ratio of the mass of the original sample to that of the diluted sample since its extinction coefficient is too low to determine an accurate concentration without employing and losing a large amount of sample.

ITC Measurements

The binding thermodynamics of the antibodies are determined from ITC measurements using a Microcal, Inc. VP Titration Calorimeter. The VP titration calorimeter consists of a matched pair of sample and reference vessels (1.409 ml) enclosed in an adiabatic

enclosure and a rotating stirrer-syringe for titrating ligand solutions into the sample vessel. The ITC measurements are performed at 25°C and 35°C. The sample vessel contained the antibody in the phosphate buffer while the reference vessel contains just the buffer solution. The phosphate buffer solution is saline 67 mM PO₄ at pH 7.4 from HyClone, Inc. Five or ten µl aliquots of the 0.05 to 0.1 mM RSV-antigen, PIV-antigen, and/or hMPV-antigen solution are titrated 3 to 4 minutes apart into the antibody sample solution until the binding is saturated as evident by the lack of a heat exchange signal.

A non-linear, least square minimization software program from Microcal, Inc., Origin 5.0, is used to fit the incremental heat of the *i*th titration ($\Delta Q(i)$) of the total heat, Q_t , to the total titrant concentration, X_t , according to the following equations (I),

$$Q_t = nC_t \Delta H_b^\circ V \{1 + X_t/nC_t + 1/nK_b C_t - [(1 + X_t/nC_t + 1/nK_b C_t)^2 - 4X_t/nC_t]^{1/2}\} / 2 \quad (1a)$$

$$\Delta Q(i) = Q(i) + dVi/2V \{Q(i) + Q(i-1)\} - Q(i-1) \quad (1b)$$

where C_t is the initial antibody concentration in the sample vessel, V is the volume of the sample vessel, and n is the stoichiometry of the binding reaction, to yield values of K_b , ΔH_b° , and n . The optimum range of sample concentrations for the determination of K_b depends on the value of K_b and is defined by the following relationship.

$$C_t K_b n \leq 500 \quad (2)$$

so that at 1 µM the maximum K_b that can be determined is less than $2.5 \times 10^8 \text{ M}^{-1}$. If the first titrant addition does not fit the binding isotherm, it was neglected in the final analysis since it may reflect release of an air bubble at the syringe opening-solution interface.

4.8.7 COTTON RAT PROPHYLAXIS

This assay is used to determine the ability of anti-RSV-antigen antibodies, anti-PIV-antigen antibodies, and/or anti-hMPV-antigen antibodies or fragments thereof to prevent lower respiratory tract viral infection in cotton rats when administered by intravenous (IV) route. In certain other embodiments, the antibodies are administered by intramuscular (IM) route or by intranasal route (IN). The antibodies can be administered by any technique well-known to the skilled artisan. This assay is also used to correlate the serum concentration of anti-RSV-antigen antibodies, anti-PIV-antigen antibodies, and/or anti-hMPV-antigen antibodies with a reduction in lung RSV, PIV, and/or hMPV, respectively, titer.

Bovine serum albumin (BSA; fraction V) can be obtained from Sigma Chemicals. RSV-Long (A subtype), RSV B subtype, PIV, or hMPV is propagated in cultured liver cells, such as, but not limited to Hep-2 cells. On day 0, groups of cotton rats (*Sigmodon*

hispidis, average weight 100 g) are administered the antibody of interest or BSA by intramuscular injection, by intravenous injection, or by intranasal route. Four days after the infection, animals are sacrificed, and their lung tissue is harvested and pulmonary virus titers are determined by plaque titration. In certain embodiments, 0.31, 0.63, 1.25, 2.5, 5.5 and 10 mg/kg (body weight) of antibody are administered. Bovine serum albumin (BSA) 10 mg/kg is used as a negative control. Antibody concentrations in the serum at the time of challenge are determined using a sandwich ELISA.

4.8.8 BIOAVAILABILITY

The percent of dose entering the systemic circulation after administration of a given dosage of antibodies (drug) is referred to as bioavailability. More explicitly, bioavailability is defined as the ratio of the amount of antibodies “absorbed” from a test formulation to the amount “absorbed” after administration of a standard formulation. Frequently, the “standard formulation” used in assessing bioavailability is the aqueous solution of the drug, given intravenously.

The amount of antibodies absorbed is taken as a measure of the ability of the formulation to deliver the antibodies to the sites of drug action; this will depend on such factors as, *e.g.*, disintegration and dissolution properties of the dosage form, and the rate of biotransformation relative to rate of absorption - dosage forms containing identical amounts of active drug may differ markedly in their abilities to make drug available, and therefore, in their abilities to permit the drug to manifest its expected pharmacodynamic and therapeutic properties.

“Amount absorbed” is conventionally measured by one of two criteria, either the area under the *time-plasma concentration curve (AUC)* or the *total (cumulative) amount of drug excreted* in the urine following drug administration. A linear relationship exists between “area under the curve” and dose when the fraction of drug absorbed is independent of dose, and elimination rate (half-life) and volume of distribution are independent of dose and dosage form. A linearity of the relationship between area under the curve and dose may occur if, for example, the absorption process is a saturable one, or if drug fails to reach the systemic circulation because of, *e.g.*, binding of drug in the intestine or biotransformation in the liver during the drug’s first transit through the portal system.

4.8.9 CLINICAL TRIALS

Antibodies of the invention or fragments thereof tested in *in vitro* assays and animal models may be further evaluated for safety, tolerance and pharmacokinetics in groups of normal healthy adult volunteers. The volunteers are administered intramuscularly, intravenously or by a pulmonary delivery system a single dose of 0.5 mg/kg, 3 mg/kg, 5 mg/kg, 10 mg/kg or 15 mg/kg of an antibody or fragment thereof which immunospecifically binds to a RSV, PIV, and/or hMPV antigen. Each volunteer is monitored at least 24 hours prior to receiving the single dose of the antibody or fragment thereof and each volunteer will be monitored for at least 48 hours after receiving the dose at a clinical site. Then volunteers are monitored as outpatients on days 3, 7, 14, 21, 28, 35, 42, 49, and 56 postdose.

Blood samples are collected via an indwelling catheter or direct venipuncture using 10 ml red-top Vacutainer tubes at the following intervals: (1) prior to administering the dose of the antibody or antibody fragment; (2) during the administration of the dose of the antibody or antibody fragment; (3) 5 minutes, 10 minutes, 15 minutes, 20 minutes, 30 minutes, 1 hour, 2 hours, 4 hours, 8 hours, 12 hours, 24 hours, and 48 hours after administering the dose of the antibody or antibody fragment; and (4) 3 days, 7 days 14 days, 21 days, 28 days, 35 days, 42 days, 49 days, and 56 days after administering the dose of the antibody or antibody fragment. Samples are allowed to clot at room temperature and serum will be collected after centrifugation.

The antibody or antibody fragment is partially purified from the serum samples and the amount of antibody or antibody fragment in the samples will be quantitated by ELISA. Briefly, the ELISA consists of coating microtiter plates overnight at 4°C with an antibody that recognizes the antibody or antibody fragment administered to the volunteer. The plates are then blocked for approximately 30 minutes at room temperature with PBS-Tween-0.5% BSA. Standard curves are constructed using purified antibody or antibody fragment, not administered to a volunteer. Samples are diluted in PBS-Tween-BSA. The samples and standards are incubated for approximately 1 hour at room temperature. Next, the bound antibody is treated with a labeled antibody (*e.g.*, horseradish peroxidase conjugated goat-anti-human IgG) for approximately 1 hour at room temperature. Binding of the labeled antibody is detected, *e.g.*, by a spectrophotometer.

The concentration of antibody or antibody fragment levels in the serum of volunteers are corrected by subtracting the predose serum level (background level) from the serum levels at each collection interval after administration of the dose. For each volunteer the pharmacokinetic parameters are computed according to the model-independent approach

(Gibaldi et al., eds., 1982, *Pharmacokinetics*, 2nd edition, Marcel Dekker, New York) from the corrected serum antibody or antibody fragment concentrations.

4.8.10 METHODS TO IDENTIFY MPV

The invention encompasses treatment of any isolates of MPV, including those which are characterized as belonging to the subgroups and variants described in section 4.1.7.1, or belonging to a yet to be characterized subgroup or variant.

Immunoassays can be used in order to characterize the protein components that are present in a given sample. Immunoassays are an effective way to compare viral isolates using peptides components of the viruses for identification. For example, a method for identifying an isolates of MPV comprises inoculating an essentially MPV-uninfected or specific-pathogen-free guinea pig or ferret (in the detailed description the animal is inoculated intranasally but other was of inoculation such as intramuscular or intradermal inoculation, and using an other experimental animal, is also feasible) with the prototype isolate I-2614 or related isolates. Sera are collected from the animal at day zero, two weeks and three weeks post inoculation. The animal specifically seroconverted as measured in virus neutralization (VN) assay and indirect immunofluorescence assay against the respective isolate I-2614 and the sera from the seroconverted animal are used in the immunological detection of said further isolates. As an example, the invention provides the characterization of a new member in the family of *Paramyxoviridae*, a human metapneumovirus or metapneumovirus-like virus (since its final taxonomy awaits discussion by a viral taxonomy committee the MPV is herein for example described as taxonomically corresponding to APV) (MPV) which may cause severe respiratory tract infection in humans. The clinical signs of the disease caused by MPV are essentially similar to those caused by hRSV, such as cough, myalgia, vomiting, fever broncheolitis or pneumonia, possible conjunctivitis, or combinations thereof. As is seen with hRSV infected children, specifically very young children may require hospitalization. As an example an MPV which was deposited January 19, 2001 as I-2614 with CNCM, Institute Pasteur, Paris or a virus isolate phylogenetically corresponding therewith can be used

4.8.10.1 PHYLOGENETIC ANALYSIS

Phylogenetic relationships between isolates of mammalian MPV can be evaluated by the methods set forth below or any other technique known to the skilled artisan. Many

methods or approaches are available to analyze phylogenetic relationship; these include distance, maximum likelihood, and maximum parsimony methods (Swofford, DL., et. al., *Phylogenetic Inference*. In *Molecular Systematics*. Eds. Hillis, DM, Mortiz, C, and Mable, BK. 1996. Sinauer Associates: Massachusetts, USA. pp. 407 - 514; Felsenstein, J., 1981, *J. Mol. Evol.* 17:368-376). In addition, bootstrapping techniques are an effective means of preparing and examining confidence intervals of resultant phylogenetic trees (Felsenstein, J., 1985, *Evolution*. 29:783-791). Any method or approach using nucleotide or peptide sequence information to compare mammalian MPV isolates can be used to establish phylogenetic relationships, including, but not limited to, distance, maximum likelihood, and maximum parsimony methods or approaches. Any method known in the art can be used to analyze the quality of phylogenetic data, including but not limited to bootstrapping. Alignment of nucleotide or peptide sequence data for use in phylogenetic approaches, include but are not limited to, manual alignment, computer pairwise alignment, and computer multiple alignment. One skilled in the art would be familiar with the preferable alignment method or phylogenetic approach to be used based upon the information required and the time allowed.

In one embodiment, a DNA maximum likelihood method is used to infer relationships between hMPV isolates. In another embodiment, bootstrapping techniques are used to determine the certainty of phylogenetic data created using one of said phylogenetic approaches. In another embodiment, jumbling techniques are applied to the phylogenetic approach before the input of data in order to minimize the effect of sequence order entry on the phylogenetic analyses. In one specific embodiment, a DNA maximum likelihood method is used with bootstrapping. In another specific embodiment, a DNA maximum likelihood method is used with bootstrapping and jumbling. In another more specific embodiment, a DNA maximum likelihood method is used with 50 bootstraps. In another specific embodiment, a DNA maximum likelihood method is used with 50 bootstraps and 3 jumbles. In another specific embodiment, a DNA maximum likelihood method is used with 100 bootstraps and 3 jumbles.

In one embodiment, nucleic acid or peptide sequence information from an isolate of hMPV is compared or aligned with sequences of other hMPV isolates. The amino acid sequence can be the amino acid sequence of the L protein, the M protein, the N protein, the P protein, or the F protein. In another embodiment, nucleic acid or peptide sequence information from an hMPV isolate or a number of hMPV isolates is compared or aligned

with sequences of other viruses. In another embodiment, phylogenetic approaches are applied to sequence alignment data so that phylogenetic relationships can be inferred and/or phylogenetic trees constructed. Any method or approach that uses nucleotide or peptide sequence information to compare hMPV isolates can be used to infer said phylogenetic relationships, including, but not limited to, distance, maximum likelihood, and maximum parsimony methods or approaches.

Other methods for the phylogenetic analysis are disclosed in International Patent Application PCT/NL02/00040, published as WO 02/057302, which is incorporated in its entirety herein. In particular, PCT/NL02/00040 discloses nucleic acid sequences that are suitable for phylogenetic analysis at page 12, line 27 to page 19, line 29, which is incorporated herein by reference.

For the phylogenetic analyses it is most useful to obtain the nucleic acid sequence of a non-MPV as outgroup with which the virus is to be compared, a very useful outgroup isolate can be obtained from avian pneumovirus serotype C (APV-C), see, *e.g.*, Figure 16.

Many methods and programs are known in the art and can be used in the inference of phylogenetic relationships, including, but not limited to BioEdit, ClustalW, TreeView, and NJPlot. Methods that would be used to align sequences and to generate phylogenetic trees or relationships would require the input of sequence information to be compared. Many methods or formats are known in the art and can be used to input sequence information, including, but not limited to, FASTA, NBRF, EMBL/SWISS, GDE protein, GDE nucleotide, CLUSTAL, and GCG/MSF. Methods that would be used to align sequences and to generate phylogenetic trees or relationships would require the output of results. Many methods or formats can be used in the output of information or results, including, but not limited to, CLUSTAL, NBRF/PIR, MSF, PHYLIP, and GDE. In one embodiment, ClustalW is used in conjunction with DNA maximum likelihood methods with 100 bootstraps and 3 jumbles in order to generate phylogenetic relationships.

4.8.10.2 ALIGNMENT OF SEQUENCES

Two or more amino acid sequences can be compared by BLAST (Altschul, S.F. *et al.*, 1990, J. Mol. Biol. 215:403-410) to determine their sequence homology and sequence identities to each other. Two or more nucleotide sequences can be compared by BLAST (Altschul, S.F. *et al.*, 1990, J. Mol. Biol. 215:403-410) to determine their sequence homology and sequence identities to each other. BLAST comparisons can be performed using the

Clustal W method (MacVector™). In certain specific embodiments, the alignment of two or more sequences by a computer program can be followed by manual re-adjustment.

The determination of percent identity between two sequences can be accomplished using a mathematical algorithm. A preferred, non-limiting example of a mathematical algorithm utilized for the comparison of two sequences is the algorithm of Karlin and Altschul, 1990, Proc. Natl. Acad. Sci. USA 87:2264-2268, modified as in Karlin and Altschul, 1993, Proc. Natl. Acad. Sci. USA 90:5873-5877. Such an algorithm is incorporated into the NBLAST and XBLAST programs of Altschul et al., 1990, J. Mol. Biol. 215:403-410. BLAST nucleotide comparisons can be performed with the NBLAST program. BLAST amino acid sequence comparisons can be performed with the XBLAST program. To obtain gapped alignments for comparison purposes, Gapped BLAST can be utilized as described in Altschul *et al.*, 1997, Nucleic Acids Res.25:3389-3402. Alternatively, PSI-Blast can be used to perform an iterated search which detects distant relationships between molecules (Altschul *et al.*, 1997, *supra*). When utilizing BLAST, Gapped BLAST, and PSI-Blast programs, the default parameters of the respective programs (*e.g.*, XBLAST and NBLAST) can be used (*see*<http://www.ncbi.nlm.nih.gov>). Another preferred, non-limiting example of a mathematical algorithm utilized for the comparison of sequences is the algorithm of Myers and Miller, 1988, CABIOS 4:11-17. Such an algorithm is incorporated into the ALIGN program (version 2.0) which is part of the GCG sequence alignment software package. When utilizing the ALIGN program for comparing amino acid sequences, a PAM120 weight residue table can be used. The gap length penalty can be set by the skilled artisan. The percent identity between two sequences can be determined using techniques similar to those described above, with or without allowing gaps. In calculating percent identity, typically only exact matches are counted.

4.8.10.3 HYBRIDIZATION CONDITIONS

A nucleic acid which is hybridizable to a nucleic acid of a mammalian MPV, or to its reverse complement, or to its complement can be used in the methods of the invention to determine their sequence homology and identities to each other. In certain embodiments, the nucleic acids are hybridized under conditions of high stringency. By way of example and not limitation, procedures using such conditions of high stringency are as follows.

Prehybridization of filters containing DNA is carried out for 8 h to overnight at 65 C in buffer composed of 6X SSC, 50 mM Tris-HCl (pH 7.5), 1 mM EDTA, 0.02% PVP, 0.02% Ficoll,

0.02% BSA, and 500 $\mu\text{g/ml}$ denatured salmon sperm DNA. Filters are hybridized for 48 h at 65 C in prehybridization mixture containing 100 $\mu\text{g/ml}$ denatured salmon sperm DNA and 5-20 X 10⁶ cpm of 32P-labeled probe. Washing of filters is done at 37 C for 1 h in a solution containing 2X SSC, 0.01% PVP, 0.01% Ficoll, and 0.01% BSA. This is followed by a wash in 0.1X SSC at 50 C for 45 min before autoradiography. Other conditions of high stringency which may be used are well known in the art. In other embodiments of the invention, hybridization is performed under moderate or low stringency conditions, such conditions are well-known to the skilled artisan (*see e.g.*, Sambrook et al., 1989, Molecular Cloning, A Laboratory Manual, 2d Ed., Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York; *see also*, Ausubel et al., eds., in the Current Protocols in Molecular Biology series of laboratory technique manuals, 1987-1997 Current Protocols, © 1994-1997 John Wiley and Sons, Inc.).

TABLE 5: LEGEND FOR SEQUENCE LISTING

SEQ ID NO:1	Human metapneumovirus isolate 00-1 matrix protein (M) and fusion protein (F) genes
SEQ ID NO:2	Avian pneumovirus fusion protein gene, partial cds
SEQ ID NO:3	Avian pneumovirus isolate 1b fusion protein mRNA, complete cds
SEQ ID NO:4	Turkey rhinotracheitis virus gene for fusion protein (F1 and F2 subunits), complete cds
SEQ ID NO:5	Avian pneumovirus matrix protein (M) gene, partial cds and Avian pneumovirus fusion glycoprotein (F) gene, complete cds
SEQ ID NO:6	paramyxovirus F protein hRSV B
SEQ ID NO:7	paramyxovirus F protein hRSV A2
SEQ ID NO:8	human metapneumovirus 01-71 (partial sequence)
SEQ ID NO:9	Human metapneumovirus isolate 00-1 matrix protein (M) and fusion protein (F) genes
SEQ ID NO:10	Avian pneumovirus fusion protein gene, partial cds
SEQ ID NO:11	Avian pneumovirus isolate 1b fusion protein mRNA, complete cds
SEQ ID NO:12	Turkey rhinotracheitis virus gene for fusion protein (F1 and F2 subunits), complete cds
SEQ ID NO:13	Avian pneumovirus fusion glycoprotein (F) gene, complete cds
SEQ ID NO:14	Turkey rhinotracheitis virus (strain CVL14/1) attachment protein (G) mRNA, complete cds
SEQ ID NO:15	Turkey rhinotracheitis virus (strain 6574) attachment protein (G), complete cds
SEQ ID NO:16	Turkey rhinotracheitis virus (strain CVL14/1) attachment protein (G) mRNA, complete cds

SEQ ID NO:17 Turkey rhinotracheitis virus (strain
6574) attachment protein (G), complete cds
SEQ ID NO:18 isolate NL/1/99 (99-1) HMPV (Human
Metapneumovirus) cDNA sequence
SEQ ID NO:19 isolate NL/1/00 (00-1) HMPV cDNA sequence
SEQ ID NO:20 isolate NL/17/00 HMPV cDNA sequence
SEQ ID NO:21 isolate NL/1/94 HMPV cDNA sequence
SEQ ID NO:22 RT-PCR primer TR1
SEQ ID NO:23 RT-PCR primer N1
SEQ ID NO:24 RT-PCR primer N2
SEQ ID NO:25 RT-PCR primer M1
SEQ ID NO:26 RT-PCR primer M2
SEQ ID NO:27 RT-PCR primer F1
SEQ ID NO:28 RT-PCR primer N3
SEQ ID NO:29 RT-PCR primer N4
SEQ ID NO:30 RT-PCR primer M3
SEQ ID NO:31 RT-PCR primer M4
SEQ ID NO:32 RT-PCR primer F7
SEQ ID NO:33 RT-PCR primer F8
SEQ ID NO:34 RT-PCR primer L6
SEQ ID NO:35 RT-PCR primer L7
SEQ ID NO:36 Oligonucleotide probe M
SEQ ID NO:37 Oligonucleotide probe N
SEQ ID NO:38 Oligonucleotide probe L
SEQ ID NO:39 TaqMan primer and probe sequences for isolates
NL/1/00, BI/1/01, FI/4/01, NL/8/01, FI/2/01
SEQ ID NO:40 TaqMan primer and probe sequences for isolates
NL/30/01
SEQ ID NO:41 TaqMan primer and probe sequences for isolates
NL/22/01 and NL/23/01
SEQ ID NO:42 TaqMan primer and probe sequences for isolate
NL/17/01
SEQ ID NO:43 TaqMan primer and probe sequences for isolate
NL/17/00
SEQ ID NO:44 TaqMan primer and probe sequences for isolates
NL/9/01, NL/21/01, and NL/5/01
SEQ ID NO:45 TaqMan primer and probe sequences for isolates
FI/1/01 and FI/10/01
SEQ ID NO:46 Primer ZF1
SEQ ID NO:47 Primer ZF4
SEQ ID NO:48 Primer ZF7
SEQ ID NO:49 Primer ZF10
SEQ ID NO:50 Primer ZF13
SEQ ID NO:51 Primer ZF16
SEQ ID NO:52 Primer CS1
SEQ ID NO:53 Primer CS4
SEQ ID NO:54 Primer CS7
SEQ ID NO:55 Primer CS10
SEQ ID NO:56 Primer CS13
SEQ ID NO:57 Primer CS16

SEQ ID NO:58 Forward primer for amplification of HPIV-1
 SEQ ID NO:59 Reverse primer for amplification of HPIV-1
 SEQ ID NO:60 Forward primer for amplification of HPIV-2
 SEQ ID NO:61 Reverse primer for amplification of HPIV-2
 SEQ ID NO:62 Forward primer for amplification of HPIV-3
 SEQ ID NO:63 Reverse primer for amplification of HPIV-3
 SEQ ID NO:64 Forward primer for amplification of HPIV-4
 SEQ ID NO:65 Reverse primer for amplification of HPIV-4
 SEQ ID NO:66 Forward primer for amplification of Mumps
 SEQ ID NO:67 Reverse primer for amplification of Mumps
 SEQ ID NO:68 Forward primer for amplification of NDV
 SEQ ID NO:69 Reverse primer for amplification of NDV
 SEQ ID NO:70 Forward primer for amplification of Tupaia
 SEQ ID NO:71 Reverse primer for amplification of Tupaia
 SEQ ID NO:72 Forward primer for amplification of Mapuera
 SEQ ID NO:73 Reverse primer for amplification of Mapuera
 SEQ ID NO:74 Forward primer for amplification of Hendra
 SEQ ID NO:75 Reverse primer for amplification of Hendra
 SEQ ID NO:76 Forward primer for amplification of Nipah
 SEQ ID NO:77 Reverse primer for amplification of Nipah
 SEQ ID NO:78 Forward primer for amplification of HRSV
 SEQ ID NO:79 Reverse primer for amplification of HRSV
 SEQ ID NO:80 Forward primer for amplification of Measles
 SEQ ID NO:81 Reverse primer for amplification of Measles
 SEQ ID NO:82 Forward primer to amplify general
 paramyxoviridae viruses
 SEQ ID NO:83 Reverse primer to amplify general paramyxoviridae
 viruses
 SEQ ID NO:84 G-gene coding sequence for isolate NL/1/00 (A1)
 SEQ ID NO:85 G-gene coding sequence for isolate BR/2/01 (A1)
 SEQ ID NO:86 G-gene coding sequence for isolate FL/4/01 (A1)
 SEQ ID NO:87 G-gene coding sequence for isolate FL/3/01 (A1)
 SEQ ID NO:88 G-gene coding sequence for isolate FL/8/01 (A1)
 SEQ ID NO:89 G-gene coding sequence for isolate FL/10/01 (A1)
 SEQ ID NO:90 G-gene coding sequence for isolate NL/10/01 (A1)
 SEQ ID NO:91 G-gene coding sequence for isolate NL/2/02 (A1)
 SEQ ID NO:92 G-gene coding sequence for isolate NL/17/00 (A2)
 SEQ ID NO:93 G-gene coding sequence for isolate NL/1/81 (A2)
 SEQ ID NO:94 G-gene coding sequence for isolate NL/1/93 (A2)
 SEQ ID NO:95 G-gene coding sequence for isolate NL/2/93 (A2)
 SEQ ID NO:96 G-gene coding sequence for isolate NL/3/93 (A2)
 SEQ ID NO:97 G-gene coding sequence for isolate NL/1/95 (A2)
 SEQ ID NO:98 G-gene coding sequence for isolate NL/2/96 (A2)
 SEQ ID NO:99 G-gene coding sequence for isolate NL/3/96 (A2)
 SEQ ID NO:100 G-gene coding sequence for isolate NL/22/01
 (A2)
 SEQ ID NO:101 G-gene coding sequence for isolate NL/24/01
 (A2)
 SEQ ID NO:102 G-gene coding sequence for isolate NL/23/01
 (A2)

SEQ ID NO:103 G-gene coding sequence for isolate NL/29/01
 (A2)
 SEQ ID NO:104 G-gene coding sequence for isolate NL/3/02 (A2)
 SEQ ID NO:105 G-gene coding sequence for isolate NL/1/99 (B1)
 SEQ ID NO:106 G-gene coding sequence for isolate NL/11/00
 (B1)
 SEQ ID NO:107 G-gene coding sequence for isolate NL/12/00
 (B1)
 SEQ ID NO:108 G-gene coding sequence for isolate NL/5/01 (B1)
 SEQ ID NO:109 G-gene coding sequence for isolate NL/9/01 (B1)
 SEQ ID NO:110 G-gene coding sequence for isolate NL/21/01
 (B1)
 SEQ ID NO:111 G-gene coding sequence for isolate NL/1/94 (B2)
 SEQ ID NO:112 G-gene coding sequence for isolate NL/1/82 (B2)
 SEQ ID NO:113 G-gene coding sequence for isolate NL/1/96 (B2)
 SEQ ID NO:114 G-gene coding sequence for isolate NL/6/97 (B2)
 SEQ ID NO:115 G-gene coding sequence for isolate NL/9/00 (B2)
 SEQ ID NO:116 G-gene coding sequence for isolate NL/3/01 (B2)
 SEQ ID NO:117 G-gene coding sequence for isolate NL/4/01 (B2)
 SEQ ID NO:118 G-gene coding sequence for isolate UK/5/01 (B2)
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 SEQ ID NO:390 attachment glycoprotein of Human respiratory syncytial virus
 SEQ ID NO:391 fusion glycoprotein of Human respiratory syncytial virus
 SEQ ID NO:392 small hydrophobic protein of Human respiratory syncytial virus
 SEQ ID NO:393 RNA polymerase beta subunit (Large structural protein) (L protein) of Human respiratory syncytial virus
 SEQ ID NO:394 phosphoprotein P of Human respiratory syncytial virus
 SEQ ID NO:395 attachment glycoprotein G of Human respiratory syncytial virus
 SEQ ID NO:396 nucleocapsid protein of Human respiratory syncytial virus
 SEQ ID NO:397 nucleoprotein (N) of Human respiratory syncytial virus
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 SEQ ID NO:400 Phosphoprotein (P)
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 SEQ ID NO:402 Matrix Protein 2-1 (M2)
 SEQ ID NO:403 Matrix Protein 2-2 (M2)
 SEQ ID NO:404 Small Hydrophobic Protein (SH)
 SEQ ID NO:405 RNA-dependent RNA polymerase (L) of Human metapneumovirus
 SEQ ID NO:406 RNA-dependent RNA polymerase (L) of Human metapneumovirus
 SEQ ID NO:407 RNA polymerase alpha subunit (Nucleocapsid phosphoprotein) of Human parainfluenza 1 virus
 SEQ ID NO:408 L polymerase protein of Human parainfluenza 1 virus
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 SEQ ID NO:410 matrix protein of Human parainfluenza 1 virus
 SEQ ID NO:411 Y1 protein of Human parainfluenza 1 virus
 SEQ ID NO:412 C protein of Human parainfluenza 1 virus
 SEQ ID NO:413 phosphoprotein of Human parainfluenza 1 virus
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 SEQ ID NO:415 F glycoprotein of Human parainfluenza 1 virus
 SEQ ID NO:416 D protein of Human parainfluenza virus 3
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 SEQ ID NO:419 P protein of Human parainfluenza virus 2
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 SEQ ID NO:421 G protein of Human parainfluenza virus
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SEQ ID NO:424 Avian pneumovirus fusion protein gene
SEQ ID NO:425 Avian pneumovirus isolate 1b fusion protein
mRNA
SEQ ID NO:426 Turkey rhinotracheitis virus gene for fusion
protein (F1 and F2 subunits), complete cds
SEQ ID NO:427 Avian pneumovirus fusion glycoprotein (F) gene,
complete cds
SEQ ID NO:428 Turkey rhinotracheitis virus (strain CVL14/1)
attachment protien (G) mRNA, complete cds
SEQ ID NO:429 Turkey rhinotracheitis virus (strain 6574)
attachment protein (G)
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SEQ ID NO:436 Postulated HRB sequence of strain NL1/99
SEQ ID NO:437 Postulated HRB sequence of strain NL1/94

Equivalents

Those skilled in the art will recognize, or be able to ascertain using no more than routine experimentation, many equivalents to the specific embodiments of the invention described herein. Such equivalents are intended to be encompassed by the following claims.

All publications, patents and patent applications mentioned in this specification are herein incorporated by reference into the specification to the same extent as if each individual publication, patent or patent application was specifically and individually indicated to be incorporated herein by reference.

WHAT IS CLAIMED IS:

1. A method of preventing a viral infection in a subject, said method comprising administering to the subject:
 - (i) a prophylactically effective amount of one or more first antibodies or antigen-binding fragments thereof, wherein one or more of said first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen; and
 - (ii) a prophylactically effective amount of one or more second antibodies or antigen-binding fragments thereof, wherein one or more of said second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen.
2. The method of claim 1, wherein one or more of said first antibodies or antigen-binding fragments thereof neutralize RSV.
3. The method of claim 1, wherein one or more of said second antibodies or antigen-binding fragments thereof neutralize hMPV.
4. The method of claim 1, wherein one or more of said first antibodies or antigen-binding fragments thereof block RSV infection of cells of the subject.
5. The method of claim 1, wherein one or more of said second antibodies or antigen-binding fragments thereof block hMPV infection of cells of the subject.
6. A method of treating one or more symptoms of a respiratory viral infection in a subject, said method comprising administering to the subject:
 - (i) a therapeutically effective amount of one or more first antibodies or antigen-binding fragments thereof, wherein one or more of said first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen; and
 - (ii) a therapeutically effective amount of one or more second antibodies or antigen-binding fragments thereof, wherein one or more of said second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen.
7. A method of passive immunotherapy, said method comprising administering to a subject:
 - (i) a first dose of one or more first antibodies or antigen-binding fragments thereof, wherein one or more of said first antibodies or a fragments thereof bind immunospecifically to a RSV antigen; and

(ii) a second dose of one or more second antibodies or antigen-binding fragments thereof, wherein one or more of said second antibodies or a fragments thereof bind immunospecifically to a hMPV antigen,

wherein the first dose reduces the incidence of RSV infection by at least 25% and wherein the second dose reduces the incidence of hMPV infection by at least 25%.

8. The method of claim 7, wherein the first dose reduces the incidence of RSV infection by at least 50% and wherein the second dose reduces the incidence of hMPV infection by at least 50%.

9. The method of claim 7, wherein the first dose reduces the incidence of RSV infection by at least 75% and wherein the second dose reduces the incidence of hMPV infection by at least 75%.

10. The method of claim 7, wherein the first dose reduces the incidence of RSV infection by at least 90% and wherein the second dose reduces the incidence of hMPV infection by at least 90%.

11. A method of passive immunotherapy, said method comprising administering to a subject:

- (i) a first dose of one or more first antibodies or antigen-binding fragments thereof, wherein one or more of said first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen; and
- (ii) a second dose of one or more second antibodies or antigen-binding fragments thereof, wherein one or more of said second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen,

wherein the serum titer of one or more of said first antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering one or more of said first antibodies or antigen-binding fragments thereof and wherein the serum titer of one or more of said second antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering one or more of said second antibodies or antigen-binding fragments thereof.

12. The method of claim 1, 6, 7, or 11, wherein the amino acid sequence of the RSV antigen is that of SEQ ID NO:390 to 398, respectively.

13. The method of claim 1, 6, 7, or 11, wherein the amino acid sequence of the RSV antigen is 90% identical to the amino acid sequence of RSV nucleoprotein, RSV phosphoprotein, RSV matrix protein, RSV small hydrophobic protein, RSV RNA-dependent RNA polymerase, RSV F protein, or RSV G protein.

14. The method of claim 1, 6, 7, or 11, wherein the RSV antigen is selected from the group consisting of RSV nucleoprotein, RSV phosphoprotein, RSV matrix protein, RSV small hydrophobic protein, RSV RNA-dependent RNA polymerase, RSV F protein, and RSV G protein.
15. The method of claim 1, 6, 7, or 11, wherein one or more of said first antibodies immunospecifically bind to an antigen of Group A or Group B RSV.
16. The method of claim 1, 6, 7, or 11, wherein the RSV antigen is RSV F protein.
17. The method of claim 1, 6, 7, or 11, wherein one or more of said second antibodies cross-react with a turkey APV antigen.
18. The method of claim 1, 6, 7, or 11, wherein one or more of said second antibodies are (i) human or humanized antibodies and (ii) cross-react with a turkey APV antigen.
19. The method of claim 17, wherein said turkey APV antigen is selected from the group consisting of turkey APV nucleoprotein, turkey APV phosphoprotein, turkey APV matrix protein, turkey APV small hydrophobic protein, turkey APV RNA-dependent RNA polymerase, turkey APV F protein, and turkey APV G protein.
20. The method of claim 17, wherein said turkey APV antigen is an antigen of avian pneumovirus type A, avian pneumovirus type B, or avian pneumovirus type C.
21. The method of claim 17, wherein the amino acid sequence of said turkey APV antigen is that of SEQ ID NO:424 to 429, respectively.
22. The method of claim 1, 6, 7, or 11, wherein the amino acid sequence of the hMPV antigen is that of SEQ ID NO: 399-406, 420, or 421, respectively.
23. The method of claim 1, 6, 7, or 11, wherein the hMPV antigen is selected from the group consisting of hMPV nucleoprotein, hMPV phosphoprotein, hMPV matrix protein, hMPV small hydrophobic protein, hMPV RNA-dependent RNA polymerase, hMPV F protein, and hMPV G protein.
24. The method of claim 1, 6, 7, or 11, wherein the hMPV antigen is hMPV F protein.
25. The method of claim 1, 6, 7, or 11, wherein the first antibody is Palivizumab; AFFF; P12f2 P12f4; P11d4; Ale9; A12a6; A13c4; A17d4; A4B4; 1X-493L1; FR H3-3F4; M3H9; Y10H6; DG; AFFF(1); 6H8; L1-7E5; L2-15B10; A13a11; A1h5; A4B4(1);A4B4-F52S; or A4B4L1FR-S28R.

26. The method of claim 1 or 6, wherein the effective amount of one or more of said first antibodies is 15 mg/kg or less.

27. The method of claim 1 or 6, wherein the effective amount of one or more of said first antibodies is 10 mg/kg or less.

28. The method of claim 1 or 6, wherein the effective amount of one or more of said first antibodies is 1 mg/kg or less.

29. The method of claim 1 or 6, wherein the effective amount of one or more of said second antibodies or antigen-binding fragments thereof is 15 mg/kg or less.

30. The method of claim 1 or 6, wherein the effective amount of one or more of said second antibodies or antigen-binding fragments thereof is 10 mg/kg or less.

31. The method of claim 1 or 6, wherein the effective amount of one or more of said second antibodies or antigen-binding fragments thereof is 1 mg/kg or less.

32. The method of claim 1, 6, 7, or 11, wherein one or more of said first antibodies or antigen-binding fragments thereof are administered at a time period prior to administering of one or more of said second antibodies or antigen-binding fragments thereof.

33. The method of claim 1, 6, 7, or 11, wherein one or more of said second antibodies or antigen-binding fragments thereof are administered at a time period prior to administering of one or more of said first antibodies or antigen-binding fragments thereof.

34. The method of claim 1, 6, 7, or 11, wherein one or more of said first antibodies or antigen-binding fragments thereof and one or more of said second antibodies or antigen-binding fragments thereof are administered concurrently.

35. The method of claim 1, 6, 7, or 11, wherein one or more of said first antibodies or antigen-binding fragments thereof are administered in a sequence of two or more administrations, wherein the administrations of one or more of said first antibodies or antigen-binding fragments thereof are separated by a time period from each other, and wherein one or more of said second antibodies or antigen-binding fragments thereof are administered before, during, or after the sequence.

36. The method of claim 1, 6, 7, or 11, wherein one or more of said first antibodies or antigen-binding fragments thereof are administered in a sequence of two or more administrations, wherein the administrations of one or more of said second antibodies or antigen-binding fragments thereof are separated by a time period from each other, and wherein one or more of said first antibodies or antigen-binding fragments thereof are administered before, during, or after the sequence.

37. The method of claim 1, 6, 7, or 11, wherein one or more of said first antibodies or antigen-binding fragments thereof and one or more of said second antibodies or antigen-binding fragments thereof are administered in a sequence of two or more administrations, wherein the administrations are separated by a time period from each other.

38. The method of claim 32, wherein the time period is at least 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, 1 week, 2 weeks, 3 weeks, 1 month, 2 months, or 3 months.

39. The method of claim 33, wherein the time period is at least 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, 1 week, 2 weeks, 3 weeks, 1 month, 2 months, or 3 months.

40. The method of claim 34, wherein the time period is at least 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, 1 week, 2 weeks, 3 weeks, 1 month, 2 months, or 3 months.

41. The method of claim 35, wherein the time period is at least 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, 1 week, 2 weeks, 3 weeks, 1 month, 2 months, or 3 months.

42. The method of claim 36, wherein the time period is at least 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, 1 week, 2 weeks, 3 weeks, 1 month, 2 months, or 3 months.

43. The method of claim 37, wherein the time period is at least 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, 1 week, 2 weeks, 3 weeks, 1 month, 2 months, or 3 months.

44. The method of claim 1, 6, 7, or 11, wherein one or more of said first antibodies or antigen-binding fragments thereof and/or one or more of said second antibodies or antigen-binding fragments thereof are administered by a nebulizer or an inhaler.

45. The method of claim 1, 6, 7, or 11, wherein one or more of said first antibodies or antigen-binding fragments thereof and/or one or more of said second antibodies or antigen-binding fragments thereof are administered intramuscularly, intravenously or subcutaneously.

46. The method of claim 1 or 6, wherein the viral infection is an infection with RSV and hMPV.

47. The method of claim 1 or 6, wherein the viral infection is an infection with RSV and APV.

48. The method of claim 1, 6, 7, or 11, wherein at least one of said antibodies is a monoclonal antibody, a synthetic antibody, an intrabody, a chimeric antibody, a human antibody, a humanized chimeric antibody, a humanized antibody, a glycosylated antibody, a multispecific antibody, a human antibody, a single-chain antibody, or a bispecific antibody.

49. The method of claim 48, wherein at least one of said antibodies is a human antibody.

50. The method of claim 48, wherein at least one of said antibodies is a humanized antibody.
51. The method of claim 48, wherein at least one of said antibodies is a synthetic antibody.
52. The method of claim 1, 6, 7, or 11, wherein the subject is a mammal.
53. The method of claim 52, wherein the mammal is a primate.
54. The method of claim 53, wherein the primate is a human.
55. The method of claim 54, wherein the human is an elderly human.
56. The method of claim 54, wherein the human is a transplant recipient.
57. The method of claim 54, wherein the human is an immunocompromised patient.
58. The method of claim 54, wherein the human is an AIDS patient.
59. The method of claim 54, wherein the human is an infant.
60. The method of claim 54, wherein the human has cystic fibrosis, bronchopulmonary dysplasia, congenital heart disease, congenital immunodeficiency, or acquired immunodeficiency or has had a bone marrow transplant.
61. The method of claim 59, wherein the infant was born prematurely or is at risk of hospitalization for a RSV infection and/or for a hMPV infection.
62. The method of claim 59, wherein the human infant was born prematurely.
63. The method of claim 62, wherein the infant was born at 32 weeks of gestational age.
64. The method of claim 62, wherein the infant was born at between 32 and 35 weeks of gestational age.
65. The method of claim 62, wherein the infant was born at more than 35 weeks of gestational age.
66. The method of claim 59, wherein the infant is more than 38 weeks of gestational age.
67. The method of claim 52, wherein the mammal is not a primate.
68. The method of claim 67, wherein the non-primate mammal is an animal model for RSV infection and/or hMPV infection.
69. The method of claim 67, wherein the non-primate mammal is a cotton rat.
70. The method of claim 1, 6, 7, or 11, wherein the antibody is administered once a month just prior to and during the RSV season.

71. The method of claim 1, 6, 7, or 11, wherein the antibody is administered every two months just prior to and during the RSV season.
72. The method of claim 1, 6, 7, or 11, wherein the antibody is administered once just prior to or during the RSV season.
73. The method of claim 1, 6, 7, or 11, wherein at least one of said fragments is a Fab fragment, a F(ab') fragment, a F(ab')₂ fragment, a Fd, a single-chain Fv, a disulfide-linked Fv, a fragment comprising a V_L domain, or a fragment comprising a V_H domain.
74. A method of preventing a viral infection in a subject, said method comprising administering to the subject:
- (i) a dose of one or more antibodies or antigen-binding fragments thereof, wherein one or more of said antibodies or antigen-binding fragments thereof
 - (i) are human or humanized, (ii) cross-react with a turkey APV antigen, and
 - (iii) bind immunospecifically to a hMPV antigen.
75. A method of treating one or more symptoms of a respiratory viral infection in a subject, said method comprising administering to the subject:
- (i) a dose of one or more antibodies or antigen-binding fragments thereof, wherein one or more of said antibodies or antigen-binding fragments thereof
 - (i) are human or humanized, (ii) cross-react with a turkey APV antigen, and
 - (iii) bind immunospecifically to a hMPV antigen.
76. A method of passive immunotherapy, said method comprising administering to a subject:
- (i) a dose of one or more antibodies or antigen-binding fragments thereof, wherein one or more of said antibodies or antigen-binding fragments thereof
 - (i) are human or humanized, (ii) cross-react with a turkey APV antigen, and
 - (iii) bind immunospecifically to a hMPV antigen,
- wherein the dose reduces the incidence of hMPV infection by at least 25%.
77. The method of claim 76, wherein the dose reduces the incidence of hMPV infection by at least 50%.
78. The method of claim 76, wherein the dose reduces the incidence of hMPV infection by at least 75%.
79. The method of claim 76, wherein the dose reduces the incidence of hMPV infection by at least 90%.
80. A method of passive immunotherapy, said method comprising administering to a subject:

- (i) a dose of one or more antibodies or antigen-binding fragments thereof, wherein one or more of said antibodies or antigen-binding fragments thereof
- (i) are human or humanized, (ii) cross-react with a turkey APV antigen, and
- (iii) bind immunospecifically to a hMPV antigen,

wherein the serum titer of one or more of said antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering one or more of said antibodies or antigen-binding fragments thereof.

81. A pharmaceutical composition, said composition comprising:

- (i) one or more first antibodies or antigen-binding fragments thereof, wherein one or more of said first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen; and
- (ii) one or more second antibodies or antigen-binding fragments thereof, wherein one or more of said second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen.

82. The pharmaceutical composition of claim 81, wherein the amino acid sequence of the RSV antigen is that of SEQ ID NO:390 to 398, respectively.

83. The pharmaceutical composition of claim 81, wherein the amino acid sequence of the RSV antigen is 90% identical to the amino acid sequence of RSV nucleoprotein, RSV phosphoprotein, RSV matrix protein, RSV small hydrophobic protein, RSV RNA-dependent RNA polymerase, RSV F protein, or RSV G protein.

84. The pharmaceutical composition of claim 81, wherein the RSV antigen is selected from the group consisting of RSV nucleoprotein, RSV phosphoprotein, RSV matrix protein, RSV small hydrophobic protein, RSV RNA-dependent RNA polymerase, RSV F protein, and RSV G protein.

85. The pharmaceutical composition of claim 81, wherein one or more of said first antibodies or antigen-binding fragments thereof immunospecifically bind to an antigen of Group A or Group B RSV.

86. The pharmaceutical composition of claim 81, wherein the RSV antigen is RSV F protein.

87. The pharmaceutical composition of claim 81, wherein one or more of said second antibodies cross-react with a turkey APV antigen.

88. The pharmaceutical composition of claim 81, wherein one or more of said second antibodies are (i) human or humanized antibodies and (ii) cross-react with a turkey APV antigen.

89. The pharmaceutical composition of claim 87, wherein said turkey APV antigen is selected from the group consisting of turkey APV nucleoprotein, turkey APV phosphoprotein, turkey APV matrix protein, turkey APV small hydrophobic protein, turkey APV RNA-dependent RNA polymerase, turkey APV F protein, and turkey APV G protein.

90. The pharmaceutical composition of claim 87, wherein said turkey APV antigen is an antigen of avian pneumovirus type A, avian pneumovirus type B, or avian pneumovirus type C.

91. The method of claim 87, wherein the amino acid sequence of said turkey APV antigen is that of SEQ ID NO:424 to 429, respectively.

92. The pharmaceutical composition of claim 81, wherein the amino acid sequence of the hMPV antigen is that of SEQ ID NO: 399-406, 420, or 421, respectively.

93. The pharmaceutical composition of claim 81, wherein the hMPV antigen is selected from the group consisting of hMPV nucleoprotein, hMPV phosphoprotein, hMPV matrix protein, hMPV small hydrophobic protein, hMPV RNA-dependent RNA polymerase, hMPV F protein, and hMPV G protein.

94. The pharmaceutical composition of claim 81, wherein the hMPV antigen is hMPV F protein.

95. The pharmaceutical composition of claim 81, wherein the first antibody is Palivizumab; AFFF; P12f2 P12f4; P11d4; Ale9; A12a6; A13c4; A17d4; A4B4; 1X-493L1; FR H3-3F4; M3H9; Y10H6; DG; AFFF(1); 6H8; L1-7E5; L2-15B10; A13a11; A1h5; A4B4(1); A4B4-F52S; or A4B4L1FR-S28R.

96. The pharmaceutical composition of claim 81, wherein at least one of said antibodies is a monoclonal antibody, a synthetic antibody, an intrabody, a chimeric antibody, a human antibody, a humanized chimeric antibody, a humanized antibody, a glycosylated antibody, a multispecific antibody, a human antibody, a single-chain antibody, or a bispecific antibody.

97. The pharmaceutical composition of claim 96, wherein at least one of said antibodies is a human antibody.

98. The pharmaceutical composition of claim 96, wherein at least one of said antibodies is a humanized antibody.

99. The pharmaceutical composition of claim 96, wherein at least one of said antibodies is a synthetic antibody.

100. The pharmaceutical composition of claim 81, wherein at least one of said fragments is a Fab fragment, a F(ab') fragment, a F(ab')₂ fragment, a Fd, a single-chain Fv, a

disulfide-linked Fv, a fragment comprising a V_L domain, or a fragment comprising a V_H domain.

101. A pharmaceutical composition, said composition comprising: one or more antibodies or antigen-binding fragments thereof, wherein one or more of said antibodies or antigen-binding fragments thereof (i) are human or humanized, (ii) cross-react with a turkey APV antigen, and (iii) bind immunospecifically to a hMPV antigen.

102. A method of preventing a viral infection in a subject, said method comprising administering to the subject:

(i) a prophylactically effective amount of one or more first antibodies or antigen-binding fragments thereof, wherein one or more of said first antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen; and

(ii) a prophylactically effective amount of one or more second antibodies or antigen-binding fragments thereof, wherein one or more of said second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen.

103. The method of claim 102, wherein one or more of said first antibodies or antigen-binding fragments thereof neutralize PIV.

104. The method of claim 102, wherein one or more of said second antibodies or antigen-binding fragments thereof neutralize hMPV.

105. The method of claim 102, wherein one or more of said first antibodies or antigen-binding fragments thereof block PIV infection of cells of the subject.

106. The method of claim 102, wherein one or more of said second antibodies or antigen-binding fragments thereof block hMPV infection of cells of the subject.

107. A method of treating one or more symptoms of a respiratory viral infection in a subject, said method comprising administering to the subject:

(i) a therapeutically effective amount of one or more first antibodies or antigen-binding fragments thereof, wherein one or more of said first antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen; and

(ii) a therapeutically effective amount of one or more second antibodies or antigen-binding fragments thereof, wherein one or more of said second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen.

108. A method of passive immunotherapy, said method comprising administering to a subject:

- (i) a first dose of one or more first antibodies or antigen-binding fragments thereof, wherein one or more of said first antibodies or a fragments thereof bind immunospecifically to a PIV antigen; and
- (ii) a second dose of one or more second antibodies or antigen-binding fragments thereof, wherein one or more of said second antibodies or a fragments thereof bind immunospecifically to a hMPV antigen,

wherein the first dose reduces the incidence of PIV infection by at least 25% and wherein the second dose reduces the incidence of hMPV infection by at least 25%.

109. The method of claim 108, wherein the first dose reduces the incidence of PIV infection by at least 50% and wherein the second dose reduces the incidence of hMPV infection by at least 50%.

110. The method of claim 108, wherein the first dose reduces the incidence of PIV infection by at least 75% and wherein the second dose reduces the incidence of hMPV infection by at least 75%.

111. The method of claim 108, wherein the first dose reduces the incidence of PIV infection by at least 90% and wherein the second dose reduces the incidence of hMPV infection by at least 90%.

112. A method of passive immunotherapy, said method comprising administering to a subject:

- (i) a first dose of one or more first antibodies or antigen-binding fragments thereof, wherein one or more of said first antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen; and
- (ii) a second dose of one or more second antibodies or antigen-binding fragments thereof, wherein one or more of said second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen,

wherein the serum titer of one or more of said first antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering one or more of said first antibodies or antigen-binding fragments thereof and wherein the serum titer of one or more of said second antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering one or more of said second antibodies or antigen-binding fragments thereof.

113. The method of claim 102, 107, 108, or 112, wherein the amino acid sequence of the PIV antigen is that of SEQ ID NO:407 to 419, respectively.

114. The method of claim 102, 107, 108, or 112, wherein the amino acid sequence of the PIV antigen is 90% identical to the amino acid sequence of PIV nucleocapsid phosphoprotein, PIV L protein, PIV matrix protein, PIV HN glycoprotein, PIV RNA-dependent RNA polymerase, PIV Y1 protein, PIV D protein, or PIV C protein.

115. The method of claim 102, 107, 108, or 112, wherein the PIV antigen is selected from the group consisting of PIV nucleocapsid phosphoprotein, PIV L protein, PIV matrix protein, PIV HN glycoprotein, PIV RNA-dependent RNA polymerase, PIV Y1 protein, PIV D protein, or PIV C protein.

116. The method of claim 102, 107, 108, or 112, wherein one or more of said first antibodies immunospecifically bind to an antigen of human PIV type 1, human PIV type 2, human PIV type 3, or human PIV type 4.

117. The method of claim 102, 107, 108, or 112, wherein the PIV antigen is PIV F protein.

118. The method of claim 102, 107, 108, or 112, wherein one or more of said second antibodies cross-react with a turkey APV antigen.

119. The method of claim 102, 107, 108, or 112, wherein one or more of said second antibodies are (i) human or humanized antibodies and (ii) cross-react with a turkey APV antigen.

120. The method of claim 118, 119, wherein said turkey APV antigen is selected from the group consisting of turkey APV nucleoprotein, turkey APV phosphoprotein, turkey APV matrix protein, turkey APV small hydrophobic protein, turkey APV RNA-dependent RNA polymerase, turkey APV F protein, and turkey APV G protein.

121. The method of claim 118, 119, wherein said turkey APV antigen is an antigen of avian pneumovirus type A, avian pneumovirus type B, or avian pneumovirus type C.

122. The method of claim 118, 119, wherein the amino acid sequence of said turkey APV antigen is that of SEQ ID NO:424 to 429, respectively.

123. The method of claim 102, 107, 108, or 112, wherein the amino acid sequence of the hMPV antigen is that of SEQ ID NO: 399-406, 420, or 421, respectively.

124. The method of claim 102, 107, 108, or 112, wherein the hMPV antigen is selected from the group consisting of hMPV nucleoprotein, hMPV phosphoprotein, hMPV

matrix protein, hMPV small hydrophobic protein, hMPV RNA-dependent RNA polymerase, hMPV F protein, and hMPV G protein.

125. The method of claim 102, 107, 108, or 112, wherein the hMPV antigen is hMPV F protein.

126. The method of claim 102 or 107, wherein the effective amount of one or more of said first antibodies is 100 mg/kg or less.

127. The method of claim 102 or 107, wherein the effective amount of one or more of said first antibodies is 10 mg/kg or less.

128. The method of claim 102 or 107, wherein the effective amount of one or more of said first antibodies is 1 mg/kg or less.

129. The method of claim 102 or 107, wherein the effective amount of one or more of said second antibodies or antigen-binding fragments thereof is 100 mg/kg or less.

130. The method of claim 102 or 107, wherein the effective amount of one or more of said second antibodies or antigen-binding fragments thereof is 10 mg/kg or less.

131. The method of claim 102 or 107, wherein the effective amount of one or more of said second antibodies or antigen-binding fragments thereof is 1 mg/kg or less.

132. The method of claim 102, 107, 108, or 112, wherein one or more of said first antibodies or antigen-binding fragments thereof are administered at a time period prior to administering of one or more of said second antibodies or antigen-binding fragments thereof.

133. The method of claim 102, 107, 108, or 112, wherein one or more of said second antibodies or antigen-binding fragments thereof are administered at a time period prior to administering of one or more of said first antibodies or antigen-binding fragments thereof.

134. The method of claim 102, 107, 108, or 112, wherein one or more of said first antibodies or antigen-binding fragments thereof and one or more of said second antibodies or antigen-binding fragments thereof are administered concurrently.

135. The method of claim 102, 107, 108, or 112, wherein one or more of said first antibodies or antigen-binding fragments thereof are administered in a sequence of two or more administrations, wherein the administrations of one or more of said first antibodies or antigen-binding fragments thereof are separated by a time period from each other, and wherein one or more of said second antibodies or antigen-binding fragments thereof are administered before, during, or after the sequence.

136. The method of claim 102, 107, 108, or 112, wherein one or more of said first antibodies or antigen-binding fragments thereof are administered in a sequence of two or

more administrations, wherein the administrations of one or more of said second antibodies or antigen-binding fragments thereof are separated by a time period from each other, and wherein one or more of said first antibodies or antigen-binding fragments thereof are administered before, during, or after the sequence.

137. The method of claim 102, 107, 108, or 112, wherein one or more of said first antibodies or antigen-binding fragments thereof and one or more of said second antibodies or antigen-binding fragments thereof are administered in a sequence of two or more administrations, wherein the administrations are separated by a time period from each other.

138. The method of claim 132, wherein the time period is at least 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, 1 week, 2 weeks, 3 weeks, 1 month, 2 months, or 3 months.

139. The method of claim 133, wherein the time period is at least 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, 1 week, 2 weeks, 3 weeks, 1 month, 2 months, or 3 months.

140. The method of claim 135, wherein the time period is at least 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, 1 week, 2 weeks, 3 weeks, 1 month, 2 months, or 3 months.

141. The method of claim 136, wherein the time period is at least 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, 1 week, 2 weeks, 3 weeks, 1 month, 2 months, or 3 months.

142. The method of claim 137, wherein the time period is at least 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, 1 week, 2 weeks, 3 weeks, 1 month, 2 months, or 3 months.

143. The method of claim 102, 107, 108, or 112, wherein one or more of said first antibodies or antigen-binding fragments thereof and/or one or more of said second antibodies or antigen-binding fragments thereof are administered by a nebulizer or an inhaler.

144. The method of claim 102, 107, 108, or 112, wherein one or more of said first antibodies or antigen-binding fragments thereof and/or one or more of said second antibodies or antigen-binding fragments thereof are administered intramuscularly, intravenously or subcutaneously.

145. The method of claim 102 or 107, wherein the viral infection is an infection with PIV and hMPV.

146. The method of claim 102 or 107, wherein the viral infection is an infection with PIV and APV.

147. The method of claim 102, 107, 108, or 112, wherein at least one of said antibodies is a monoclonal antibody, a synthetic antibody, an intrabody, a chimeric antibody, a human antibody, a humanized chimeric antibody, a humanized antibody, a glycosylated antibody, a multispecific antibody, a human antibody, a single-chain antibody, or a bispecific antibody.

148. The method of claim 147, wherein at least one of said antibodies is a human antibody.
149. The method of claim 147, wherein at least one of said antibodies is a humanized antibody.
150. The method of claim 147, wherein at least one of said antibodies is a synthetic antibody.
151. The method of claim 102, 107, 108, or 112, wherein the subject is a mammal.
152. The method of claim 151, wherein the mammal is a primate.
153. The method of claim 152, wherein the primate is a human.
154. The method of claim 153, wherein the human is an elderly human.
155. The method of claim 153, wherein the human is a transplant recipient.
156. The method of claim 153, wherein the human is an immunocompromised patient.
157. The method of claim 153, wherein the human is an AIDS patient.
158. The method of claim 153, wherein the human is an infant.
159. The method of claim 153, wherein the human has cystic fibrosis, bronchopulmonary dysplasia, congenital heart disease, congenital immunodeficiency, or acquired immunodeficiency or has had a bone marrow transplant.
160. The method of claim 158, wherein the infant was born prematurely or is at risk of hospitalization for a PIV infection and/or a hMPV infection.
161. The method of claim 158, wherein the infant was born prematurely.
162. The method of claim 161, wherein the infant was born at less than 32 weeks of gestational age.
163. The method of claim 161, wherein the infant was born at 32 and 35 weeks of gestational age.
164. The method of claim 161, wherein the infant was born at 35 weeks of gestational age.
165. The method of claim 158, wherein the infant is more than 38 weeks of gestational age.
166. The method of claim 151, wherein the mammal is not a primate.
167. The method of claim 166, wherein the non-primate mammal is an animal model for PIV infection and/or hMPV infection.
168. The method of claim 166, wherein the non-primate mammal is a cotton rat.

169. The method of claim 102, 107, 108, or 112, wherein the antibody is administered once a month just prior to and during the PIV season.

170. The method of claim 102, 107, 108, or 112, wherein the antibody is administered every two months just prior to and during the PIV season.

171. The method of claim 102, 107, 108, or 112, wherein the antibody is administered once just prior to or during the PIV season.

172. The method of claim 102, 107, 108, or 112, wherein at least one of said fragments is a Fab fragment, a F(ab') fragment, a F(ab')₂ fragment, a Fd, a single-chain Fv, a disulfide-linked Fv, a fragment comprising a V_L domain, or a fragment comprising a V_H domain.

173. A method of preventing a viral infection in a subject, said method comprising administering to the subject:

(i) a prophylactically effective amount of one or more first antibodies or antigen-binding fragments thereof, wherein one or more of said first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen;

(ii) a prophylactically effective amount of one or more second antibodies or antigen-binding fragments thereof, wherein one or more of said second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen; and

(iii) a prophylactically effective amount of one or more third antibodies or antigen-binding fragments thereof, wherein one or more of said third antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen.

174. The method of claim 173, wherein one or more of said first antibodies or antigen-binding fragments thereof neutralize RSV.

175. The method of claim 173, wherein one or more of said second antibodies or antigen-binding fragments thereof neutralize hMPV.

176. The method of claim 173, wherein one or more of said third antibodies or antigen-binding fragments thereof neutralize PIV.

177. The method of claim 173, wherein one or more of said first antibodies or antigen-binding fragments thereof block RSV infection of cells of the subject.

178. The method of claim 173, wherein one or more of said second antibodies or antigen-binding fragments thereof block hMPV infection of cells of the subject.

179. The method of claim 173, wherein one or more of said third antibodies or antigen-binding fragments thereof block PIV infection of cells of the subject.

180. A method of treating one or more symptoms of a respiratory viral infection in a subject, said method comprising administering to the subject:

- (i) a therapeutically effective amount of one or more first antibodies or antigen-binding fragments thereof, wherein one or more of said first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen;
- (ii) a therapeutically effective amount of one or more second antibodies or antigen-binding fragments thereof, wherein one or more of said second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen; and
- (iii) a therapeutically effective amount of one or more third antibodies or antigen-binding fragments thereof, wherein one or more of said third antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen.

181. A method of passive immunotherapy, said method comprising administering to a subject:

- (i) a first dose of one or more first antibodies or antigen-binding fragments thereof, wherein one or more of said first antibodies or a fragments thereof bind immunospecifically to a RSV antigen;
- (ii) a second dose of one or more second antibodies or antigen-binding fragments thereof, wherein one or more of said second antibodies or a fragments thereof bind immunospecifically to a hMPV antigen; and
- (iii) a third dose of one or more third antibodies or antigen-binding fragments thereof, wherein one or more of said third antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen.

wherein the first dose reduces the incidence of RSV infection by at least 25%, wherein the second dose reduces the incidence of hMPV infection by at least 25%, and wherein the third dose reduces the incidence of PIV infection by at least 25%.

182. The method of claim 181, wherein the first dose reduces the incidence of RSV infection by at least 50%, wherein the second dose reduces the incidence of hMPV infection by at least 50%, and wherein the third dose reduces the incidence of PIV infection by at least 50%.

183. The method of claim 181, wherein the first dose reduces the incidence of RSV infection by at least 75%, wherein the second dose reduces the incidence of hMPV infection by at least 75%, and wherein the third dose reduces the incidence of PIV infection by at least 75%.

184. The method of claim 181, wherein the first dose reduces the incidence of RSV infection by at least 90%, wherein the second dose reduces the incidence of hMPV infection by at least 90%, and wherein the third antibody reduces the incidence of PIV infection by at least 90%.

185. A method of passive immunotherapy, said method comprising administering to a subject:

- (i) a first dose of one or more first antibodies or antigen-binding fragments thereof, wherein one or more of said first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen;
- (ii) a second dose of one or more second antibodies or antigen-binding fragments thereof, wherein one or more of said second antibodies or antigen-binding fragments thereof bind immunospecifically to a hMPV antigen; and
- (iii) a third dose of one or more third antibodies or antigen-binding fragments thereof, wherein one or more of said third antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen,

wherein the serum titer of one or more of said first antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering one or more of said first antibodies or antigen-binding fragments thereof, wherein the serum titer of one or more of said second antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering one or more of said second antibodies or antigen-binding fragments thereof, and wherein the serum titer of one or more of said third antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering one or more of said third antibodies or antigen-binding fragments thereof.

186. The method of claim 173, 180, 181, or 185, wherein the amino acid sequence of the PIV antigen is that of SEQ ID NO:407 to 419, respectively.

187. The method of claim 173, 180, 181, or 185, wherein the amino acid sequence of the PIV antigen is 90% identical to the amino acid sequence of PIV nucleoprotein, PIV phosphoprotein, PIV matrix protein, PIV small hydrophobic protein, PIV RNA-dependent RNA polymerase, PIV F protein, or PIV G protein.

188. The method of claim 173, 180, 181, or 185, wherein the PIV antigen is selected from the group consisting of PIV nucleoprotein, PIV phosphoprotein, PIV matrix protein, PIV small hydrophobic protein, PIV RNA-dependent RNA polymerase, PIV F protein, and PIV G protein.

189. A method of preventing a viral infection in a subject, said method comprising administering to the subject:

(i) a prophylactically effective amount of one or more first antibodies or antigen-binding fragments thereof, wherein one or more of said first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen; and

(ii) a prophylactically effective amount of one or more second antibodies or antigen-binding fragments thereof, wherein one or more of said second antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen.

190. The method of claim 189 wherein one or more of said first antibodies or antigen-binding fragments thereof neutralize RSV.

191. The method of claim 189, wherein one or more of said second antibodies or antigen-binding fragments thereof neutralize PIV.

192. The method of claim 189, wherein one or more of said first antibodies or antigen-binding fragments thereof block RSV infection of cells of the subject.

193. The method of claim 189, wherein one or more of said second antibodies or antigen-binding fragments thereof block PIV infection of cells of the subject.

194. A method of treating one or more symptoms of a respiratory viral infection in a subject, said method comprising administering to the subject:

(i) a therapeutically effective amount of one or more first antibodies or antigen-binding fragments thereof, wherein one or more of said first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen; and

(ii) a therapeutically effective amount of one or more second antibodies or antigen-binding fragments thereof, wherein one or more of said second antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen.

195. A method of passive immunotherapy, said method comprising administering to a subject:

(i) a first dose of one or more first antibodies or antigen-binding fragments thereof, wherein one or more of said first antibodies or a fragments thereof bind immunospecifically to a RSV antigen; and

(ii) a second dose of one or more second antibodies or antigen-binding fragments thereof, wherein one or more of said second antibodies or a fragments thereof bind immunospecifically to a PIV antigen,

wherein the first dose reduces the incidence of RSV infection by at least 25% and wherein the second dose reduces the incidence of PIV infection by at least 25%.

196. The method of claim 195, wherein the first dose reduces the incidence of RSV infection by at least 50% and wherein the second dose reduces the incidence of hMPV infection by at least 50%.

197. The method of claim 195, wherein the first dose reduces the incidence of RSV infection by at least 75% and wherein the second dose reduces the incidence of hMPV infection by at least 75%.

198. The method of claim 195, wherein the first dose reduces the incidence of RSV infection by at least 90% and wherein the second dose reduces the incidence of hMPV infection by at least 90%.

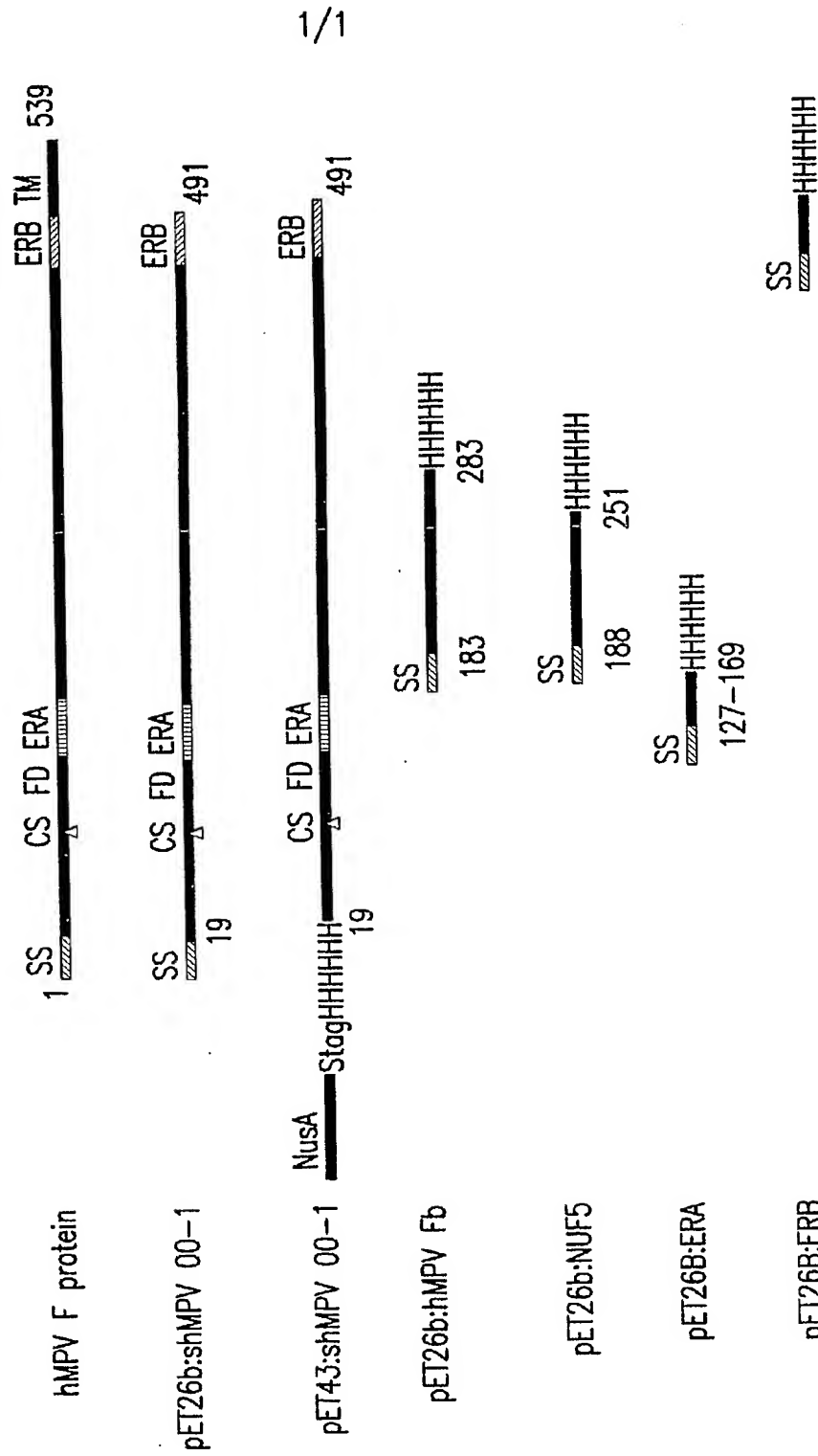
199. A method of passive immunotherapy, said method comprising administering to a subject:

(i) a first dose of one or more first antibodies or antigen-binding fragments thereof, wherein one or more of said first antibodies or antigen-binding fragments thereof bind immunospecifically to a RSV antigen; and

(ii) a second dose of one or more second antibodies or antigen-binding fragments thereof, wherein one or more of said second antibodies or antigen-binding fragments thereof bind immunospecifically to a PIV antigen,

wherein the serum titer of one or more of said first antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering one or more of said first antibodies or antigen-binding fragments thereof and wherein the serum titer of one or more of said second antibodies or antigen-binding fragments thereof in the subject is at least 10 $\mu\text{g/ml}$ after 15 days of administering one or more of said second antibodies or antigen-binding fragments thereof.

BACTERIAL EXPRESSION CONSTRUCTS



1/1

FIG.1

SEQUENCE LISTING

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<120> METHODS OF TREATING AND PREVENTING RSV, HMPV, AND PIV USING ANTI-RSV, ANTI-HMPV, AND ANTI-PIV ANTIBODIES

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<140> To be assigned

<141> Herewith

<150> 60/398,475

<151> 2002-07-25

<160> 437

<170> FastSEQ for Windows Version 4.0

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<213> metapneumovirus

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<223> Human metapneumovirus isolate 00-1 matrix protein (M) and fusion protein (F) genes

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Arg Thr Gly Trp Tyr Thr Ser Val Ile Thr Ile Glu Leu Ser Asn Ile
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Thr Asp Arg Gly Trp Tyr Cys Asp Asn Ala Gly Ser Val Ser Phe Phe
           340           345           350
Pro Gln Ala Asp Thr Cys Lys Val Gln Ser Asn Arg Val Phe Cys Asp
           355           360           365
Thr Met Asn Ser Leu Thr Leu Pro Ser Glu Val Ser Leu Cys Asn Thr
           370           375           380
Asp Ile Phe Asn Ser Lys Tyr Asp Cys Lys Ile Met Thr Ser Lys Thr

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385          390          395          400
Asp Ile Ser Ser Ser Val Ile Thr Ser Leu Gly Ala Ile Val Ser Cys
          405          410          415
Tyr Gly Lys Thr Lys Cys Thr Ala Ser Asn Lys Asn Arg Gly Ile Ile
          420          425          430

Lys Thr Phe Ser Asn Gly Cys Asp Tyr Val Ser Asn Lys Gly Val Asp
          435          440          445
Thr Val Ser Val Gly Asn Thr Leu Tyr Tyr Val Asn Lys Leu Glu Gly
          450          455          460
Lys Asn Leu Tyr Val Lys Gly Glu Pro Ile Ile Asn Tyr Tyr Asp Pro
          465          470          475          480
Leu Val Phe Pro Ser Asp Glu Phe Asp Ala Ser Ile Ser Gln Val Asn
          485          490          495
Glu Lys Ile Asn Gln Ser Leu Ala Phe Ile Arg Arg Ser Asp Glu Leu
          500          505          510
Leu His Asn Val Asn Thr Gly Lys Ser Thr Thr Asn Ile Met Ile Thr
          515          520          525
Thr Ile Ile Ile Val Ile Ile Val Val Leu Leu Ser Leu Ile Ala Ile
          530          535          540
Gly Leu Leu Leu Tyr Cys Lys Ala Lys Asn Thr Pro Val Thr Leu Ser
          545          550          555          560
Lys Asp Gln Leu Ser Gly Ile Asn Asn Ile Ala Phe Ser Lys
          565          570

```

<210> 7
 <211> 574
 <212> PRT
 <213> paramyxovirus

<220>
 <223> paramyxovirus F protein hRSV A2

```

<400> 7
Met Glu Leu Leu Ile Leu Lys Ala Asn Ala Ile Thr Thr Ile Leu Thr
1          5          10          15
Ala Val Thr Phe Cys Phe Ala Ser Gly Gln Asn Ile Thr Glu Glu Phe
          20          25          30
Tyr Gln Ser Thr Cys Ser Ala Val Ser Lys Gly Tyr Leu Ser Ala Leu
          35          40          45
Arg Thr Gly Trp Tyr Thr Ser Val Ile Thr Ile Glu Leu Ser Asn Ile
          50          55          60
Lys Glu Asn Lys Cys Asn Gly Thr Asp Ala Lys Val Lys Leu Ile Lys
          65          70          75          80
Gln Glu Leu Asp Lys Tyr Lys Asn Ala Val Thr Glu Leu Gln Leu Leu
          85          90          95
Met Gln Ser Thr Pro Pro Thr Asn Asn Arg Ala Arg Arg Glu Leu Pro
          100          105          110
Arg Phe Met Asn Tyr Thr Leu Asn Asn Ala Lys Lys Thr Asn Val Thr
          115          120          125
Leu Ser Lys Lys Arg Lys Arg Arg Phe Leu Gly Phe Leu Leu Gly Val
          130          135          140
Gly Ser Ala Ile Ala Ser Gly Val Ala Val Ser Lys Val Leu His Leu
          145          150          155          160
Glu Gly Glu Val Asn Lys Ile Lys Ser Ala Leu Leu Ser Thr Asn Lys
          165          170          175
Ala Val Val Ser Leu Ser Asn Gly Val Ser Val Leu Thr Ser Lys Val
          180          185          190
Leu Asp Leu Lys Asn Tyr Ile Asp Lys Gln Leu Leu Pro Ile Val Asn
          195          200          205

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Lys Gln Ser Cys Ser Ile Ser Asn Ile Glu Thr Val Ile Glu Phe Gln
 210                      215                      220
Gln Lys Asn Asn Arg Leu Leu Glu Ile Thr Arg Glu Phe Ser Val Asn
225                      230                      235                      240
Ala Gly Val Thr Thr Pro Val Ser Thr Tyr Met Leu Thr Asn Ser Glu
                      245                      250                      255
Leu Leu Ser Leu Ile Asn Asp Met Pro Ile Thr Asn Asp Gln Lys Lys
 260                      265                      270
Leu Met Ser Asn Asn Val Gln Ile Val Arg Gln Gln Ser Tyr Ser Ile
 275                      280                      285
Met Ser Ile Ile Lys Glu Glu Val Leu Ala Tyr Val Val Gln Leu Pro
 290                      295                      300
Leu Tyr Gly Val Ile Asp Thr Pro Cys Trp Lys Leu His Thr Ser Pro
305                      310                      315                      320
Leu Cys Thr Thr Asn Thr Lys Glu Gly Ser Asn Ile Cys Leu Thr Arg
                      325                      330                      335
Thr Asp Arg Gly Trp Tyr Cys Asp Asn Ala Gly Ser Val Ser Phe Phe
 340                      345                      350
Pro Gln Ala Glu Thr Cys Lys Val Gln Ser Asn Arg Val Phe Cys Asp
 355                      360                      365
Thr Met Asn Ser Leu Thr Leu Pro Ser Glu Ile Asn Leu Cys Asn Val
 370                      375                      380
Asp Ile Phe Asn Pro Lys Tyr Asp Cys Lys Ile Met Thr Ser Lys Thr
385                      390                      395                      400
Asp Val Ser Ser Ser Val Ile Thr Ser Leu Gly Ala Ile Val Ser Cys
                      405                      410                      415
Tyr Gly Lys Thr Lys Cys Thr Ala Ser Asn Lys Asn Arg Gly Ile Ile
 420                      425                      430
Lys Thr Phe Ser Asn Gly Cys Asp Tyr Val Ser Asn Lys Gly Met Asp
 435                      440                      445
Thr Val Ser Val Gly Asn Thr Leu Tyr Tyr Val Asn Lys Gln Glu Gly
 450                      455                      460
Lys Ser Leu Tyr Val Lys Gly Glu Pro Ile Ile Asn Phe Tyr Asp Pro
465                      470                      475                      480
Leu Val Phe Pro Ser Asp Glu Phe Asp Ala Ser Ile Ser Gln Val Asn
                      485                      490                      495
Glu Lys Ile Asn Gln Ser Leu Ala Phe Ile Arg Lys Ser Asp Glu Leu
 500                      505                      510
Leu His Asn Val Asn Ala Gly Lys Ser Thr Thr Asn Ile Met Ile Thr
 515                      520                      525
Thr Ile Ile Ile Val Ile Ile Val Ile Leu Leu Ser Leu Ile Ala Val
 530                      535                      540
Gly Leu Leu Leu Tyr Cys Lys Ala Arg Ser Thr Pro Val Thr Leu Ser
545                      550                      555                      560
Lys Asp Gln Leu Ser Gly Ile Asn Asn Ile Ala Phe Ser Asn
                      565                      570

```

<210> 8

<211> 121

<212> PRT

<213> metapneumovirus

<220>

<223> human metapneumovirus01-71 (partial sequence)

<400> 8

```

Leu Leu Ile Thr Pro Gln His Gly Leu Lys Glu Ser Tyr Leu Glu Glu
 1                      5                      10                      15
Ser Cys Ser Thr Ile Thr Glu Gly Tyr Leu Ser Val Leu Arg Thr Gly
                      20                      25                      30

```

Trp Tyr Thr Asn Val Phe Thr Leu Glu Val Gly Asp Val Glu Asn Leu
 35 40 45

Thr Cys Ala Asp Gly Pro Ser Leu Ile Lys Thr Glu Leu Asp Leu Thr
 50 55 60

Lys Ser Ala Leu Arg Glu Leu Arg Thr Val Ser Ala Asp Gln Leu Ala
 65 70 75 80

Arg Glu Glu Gln Ile Glu Asn Pro Arg Gln Ser Arg Phe Val Leu Gly
 85 90 95

Ala Ile Ala Leu Gly Val Ala Thr Ala Ala Val Thr Ala Gly Val
 100 105 110

Ala Ile Ala Lys Thr Ile Arg Leu Glu
 115 120

<210> 9

<211> 539

<212> PRT

<213> metapneumovirus

<220>

<223> Human metapneumovirus isolate 00-1 matrix protein
 (M) and fusion protein (F) genes

<400> 9

Met Ser Trp Lys Val Val Ile Ile Phe Ser Leu Leu Ile Thr Pro Gln
 1 5 10 15

His Gly Leu Lys Glu Ser Tyr Leu Glu Ser Cys Ser Thr Ile Thr
 20 25 30

Glu Gly Tyr Leu Ser Val Leu Arg Thr Gly Trp Tyr Thr Asn Val Phe
 35 40 45

Thr Leu Glu Val Gly Asp Val Glu Asn Leu Thr Cys Ala Asp Gly Pro
 50 55 60

Ser Leu Ile Lys Thr Glu Leu Asp Leu Thr Lys Ser Ala Leu Arg Glu
 65 70 75 80

Leu Arg Thr Val Ser Ala Asp Gln Leu Ala Arg Glu Glu Gln Ile Glu
 85 90 95

Asn Pro Arg Gln Ser Arg Phe Val Leu Gly Ala Ile Ala Leu Gly Val
 100 105 110

Ala Thr Ala Ala Ala Val Thr Ala Gly Val Ala Ile Ala Lys Thr Ile
 115 120 125

Arg Leu Glu Ser Glu Val Thr Ala Ile Lys Asn Ala Leu Lys Lys Thr
 130 135 140

Asn Glu Ala Val Ser Thr Leu Gly Asn Gly Val Arg Val Leu Ala Thr
 145 150 155 160

Ala Val Arg Glu Leu Lys Asp Phe Val Ser Lys Asn Leu Thr Arg Ala
 165 170 175

Ile Asn Lys Asn Lys Cys Asp Ile Ala Asp Leu Lys Met Ala Val Ser
 180 185 190

Phe Ser Gln Phe Asn Arg Arg Phe Leu Asn Val Val Arg Gln Phe Ser
 195 200 205

Asp Asn Ala Gly Ile Thr Pro Ala Ile Ser Leu Asp Leu Met Thr Asp
 210 215 220

Ala Glu Leu Ala Arg Ala Val Ser Asn Met Pro Thr Ser Ala Gly Gln
 225 230 235 240

Ile Lys Leu Met Leu Glu Asn Arg Ala Met Val Arg Arg Lys Gly Phe
 245 250 255

Gly Phe Leu Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln
 260 265 270

Leu Pro Ile Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala
 275 280 285

Ala Pro Ser Cys Ser Gly Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg
 290 295 300
 Glu Asp Gln Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr
 305 310 315 320
 Pro Asn Glu Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp
 325 330 335
 Thr Ala Ala Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile
 340 345 350
 Asn Ile Ser Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His
 355 360 365
 Pro Ile Ser Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys
 370 375 380
 Tyr Lys Gly Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile
 385 390 395 400
 Lys Gln Leu Asn Lys Gly Cys Ser Tyr Ile Thr Asn Gln Asp Ala Asp
 405 410 415
 Thr Val Thr Ile Asp Asn Thr Val Tyr Gln Leu Ser Lys Val Glu Gly
 420 425 430
 Glu Gln His Val Ile Lys Gly Arg Pro Val Ser Ser Ser Phe Asp Pro
 435 440 445
 Val Lys Phe Pro Glu Asp Gln Phe Asn Val Ala Leu Asp Gln Val Phe
 450 455 460
 Glu Ser Ile Glu Asn Ser Gln Ala Leu Val Asp Gln Ser Asn Arg Ile
 465 470 475 480
 Leu Ser Ser Ala Glu Lys Gly Asn Thr Gly Phe Ile Ile Val Ile Ile
 485 490 495
 Leu Ile Ala Val Leu Gly Ser Thr Met Ile Leu Val Ser Val Phe Ile
 500 505 510
 Ile Ile Lys Lys Thr Lys Arg Pro Thr Gly Ala Pro Pro Glu Leu Ser
 515 520 525
 Gly Val Thr Asn Asn Gly Phe Ile Pro His Asn
 530 535

<210> 10

<211> 532

<212> PRT

<213> Avian pneumovirus

<220>

<223> Avian pneumovirus fusion protein gene, partial cds

<400> 10

Met Ser Trp Lys Val Val Leu Leu Leu Val Leu Leu Ala Thr Pro Thr
 1 5 10 15
 Gly Gly Leu Glu Glu Ser Tyr Leu Glu Ser Cys Ser Thr Val Thr
 20 25 30
 Arg Gly Tyr Leu Ser Val Leu Arg Thr Gly Trp Tyr Thr Asn Val Phe
 35 40 45
 Thr Leu Gly Val Gly Asp Val Lys Asn Leu Thr Cys Thr Asp Gly Pro
 50 55 60
 Ser Leu Ile Arg Thr Glu Leu Glu Leu Thr Lys Asn Ala Leu Glu Glu
 65 70 75 80
 Leu Lys Thr Val Ser Ala Asp Gln Leu Ala Lys Glu Ala Arg Ile Met
 85 90 95
 Ser Pro Arg Lys Ala Arg Phe Val Leu Gly Ala Ile Ala Leu Gly Val
 100 105 110
 Ala Thr Ala Ala Ala Val Thr Ala Gly Val Ala Ile Ala Lys Thr Ile
 115 120 125
 Arg Leu Glu Gly Glu Val Ala Ala Ile Lys Gly Ala Leu Arg Lys Thr
 130 135 140
 Asn Glu Ala Val Ser Thr Leu Gly Asn Gly Val Arg Val Leu Ala Thr

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145          150          155          160
Ala Val Asn Asp Leu Lys Asp Phe Ile Ser Lys Lys Leu Thr Pro Ala
          165          170          175
Ile Asn Arg Asn Lys Cys Asp Ile Ser Asp Leu Lys Met Ala Val Ser
          180          185          190
Phe Gly Gln Tyr Asn Arg Arg Phe Leu Asn Val Val Arg Gln Phe Ser
          195          200          205
Asp Asn Ala Gly Ile Thr Pro Ala Ile Ser Leu Asp Leu Met Thr Asp
          210          215          220
Ala Glu Leu Val Arg Ala Val Ser Asn Met Pro Thr Ser Ser Gly Gln
225          230          235          240
Ile Asn Leu Met Leu Glu Asn Arg Ala Met Val Arg Arg Lys Gly Phe
          245          250          255
Gly Ile Leu Ile Gly Val Tyr Gly Ser Ser Val Val Tyr Ile Val Gln
          260          265          270
Leu Pro Ile Phe Gly Val Ile Asp Thr Pro Cys Trp Arg Val Lys Ala
          275          280          285
Ala Pro Leu Cys Ser Gly Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg
          290          295          300
Glu Asp Gln Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr
305          310          315          320
Pro Asn Glu Glu Asp Cys Glu Val Arg Ser Asp His Val Phe Cys Asp
          325          330          335
Thr Ala Ala Gly Ile Asn Val Ala Lys Glu Ser Glu Glu Cys Asn Arg
          340          345          350
Asn Ile Ser Thr Thr Lys Tyr Pro Cys Lys Val Ser Thr Gly Arg His
          355          360          365
Pro Ile Ser Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys
          370          375          380
Tyr Asp Gly Met Ser Cys Ser Ile Gly Ser Asn Lys Val Gly Ile Ile
385          390          395          400
Arg Pro Leu Gly Lys Gly Cys Ser Tyr Ile Ser Asn Gln Asp Ala Asp
          405          410          415
Thr Val Thr Ile Asp Asn Thr Val Tyr Gln Leu Ser Lys Val Glu Gly
          420          425          430
Glu Gln His Thr Ile Lys Gly Lys Pro Val Ser Ser Asn Phe Asp Pro
          435          440          445
Ile Glu Phe Pro Glu Asp Gln Phe Asn Val Ala Leu Asp Gln Val Phe
          450          455          460
Glu Ser Val Glu Lys Ser Gln Asn Leu Ile Asp Gln Ser Asn Lys Ile
465          470          475          480
Leu Asp Ser Ile Glu Lys Gly Asn Ala Gly Phe Val Ile Val Ile Val
          485          490          495
Leu Ile Val Leu Leu Met Leu Ala Ala Val Gly Val Gly Val Phe Phe
          500          505          510
Val Val Lys Lys Arg Lys Ala Ala Pro Lys Phe Pro Met Glu Met Asn
          515          520          525
Gly Val Asn Asn
530

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<210> 11

<211> 537

<212> PRT

<213> Avian pneumovirus

<220>

<223> Avian pneumovirus isolate 1b fusion protein mRNA,
complete cds

<400> 11

Met Ser Trp Lys Val Val Leu Leu Leu Val Leu Leu Ala Thr Pro Thr

1	5	10	15
Gly Gly Leu Glu Glu Ser Tyr Leu Glu Glu Ser Cys Ser Thr Val Thr			
20	25	30	
Arg Gly Tyr Leu Ser Val Leu Arg Thr Gly Trp Tyr Thr Asn Val Phe			
35	40	45	
Thr Leu Glu Val Gly Asp Val Glu Asn Leu Thr Cys Thr Asp Gly Pro			
50	55	60	
Ser Leu Ile Arg Thr Glu Leu Glu Leu Thr Lys Asn Ala Leu Glu Glu			
65	70	75	80
Leu Lys Thr Val Ser Ala Asp Gln Leu Ala Lys Glu Ala Arg Ile Met			
85	90	95	
Ser Pro Arg Lys Ala Arg Phe Val Leu Gly Ala Ile Ala Leu Gly Val			
100	105	110	
Ala Thr Ala Ala Ala Val Thr Ala Gly Val Ala Ile Ala Lys Thr Ile			
115	120	125	
Arg Leu Glu Gly Glu Val Ala Ala Ile Lys Gly Ala Leu Arg Lys Thr			
130	135	140	
Asn Glu Ala Val Ser Thr Leu Gly Asn Gly Val Arg Val Leu Ala Thr			
145	150	155	160
Ala Val Asn Asp Leu Lys Asp Phe Ile Ser Lys Lys Leu Thr Pro Ala			
165	170	175	
Ile Asn Arg Asn Lys Cys Asp Ile Ser Asp Leu Lys Met Ala Val Ser			
180	185	190	
Phe Gly Gln Tyr Asn Arg Arg Phe Leu Asn Val Val Arg Gln Phe Ser			
195	200	205	
Asp Asn Ala Gly Ile Thr Pro Ala Ile Ser Leu Asp Leu Met Thr Asp			
210	215	220	
Ala Glu Leu Val Arg Ala Val Ser Asn Met Pro Thr Ser Ser Gly Gln			
225	230	235	240
Ile Asn Leu Met Leu Glu Asn Arg Ala Met Val Arg Arg Lys Gly Phe			
245	250	255	
Gly Ile Leu Ile Gly Val Tyr Gly Ser Ser Val Val Tyr Ile Val Gln			
260	265	270	
Leu Pro Ile Phe Gly Val Ile Asp Thr Pro Cys Trp Lys Val Lys Ala			
275	280	285	
Ala Pro Leu Cys Ser Gly Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg			
290	295	300	
Glu Asp Gln Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr			
305	310	315	320
Pro Asn Glu Glu Asp Cys Glu Val Arg Ser Asp His Val Phe Cys Asp			
325	330	335	
Thr Ala Ala Gly Ile Asn Val Ala Lys Glu Ser Glu Glu Cys Asn Arg			
340	345	350	
Asn Ile Ser Thr Thr Lys Tyr Pro Cys Lys Val Ser Thr Gly Arg His			
355	360	365	
Pro Ile Ser Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys			
370	375	380	
Tyr Asp Gly Met Ser Cys Ser Ile Gly Ser Asn Lys Val Gly Ile Ile			
385	390	395	400
Arg Pro Leu Gly Lys Gly Cys Ser Tyr Ile Ser Asn Gln Asp Ala Asp			
405	410	415	
Thr Val Thr Ile Asp Asn Thr Val Tyr Gln Leu Ser Lys Val Glu Gly			
420	425	430	
Glu Gln His Thr Ile Lys Gly Lys Pro Val Ser Ser Asn Phe Asp Pro			
435	440	445	
Ile Glu Phe Pro Glu Asp Gln Phe Asn Val Ala Leu Asp Gln Val Phe			
450	455	460	
Glu Ser Val Glu Lys Ser Gln Asn Leu Ile Asp Gln Ser Asn Lys Ile			
465	470	475	480
Leu Asp Ser Ile Glu Lys Gly Asn Ala Gly Phe Val Ile Val Ile Val			

485 490 495
 Leu Ile Val Leu Leu Met Leu Ala Ala Val Gly Val Gly Val Phe Phe
 500 505 510
 Val Val Lys Lys Arg Lys Ala Ala Pro Lys Phe Pro Met Glu Met Asn
 515 520 525
 Gly Val Asn Asn Lys Gly Phe Ile Pro
 530 535

<210> 12

<211> 538

<212> PRT

<213> Turkey rhinotracheitis virus

<220>

<223> Turkey rhinotracheitis virus gene for fusion
protein (F1 and F2 subunits), complete cds

<400> 12

Met Asp Val Arg Ile Cys Leu Leu Leu Phe Leu Ile Ser Asn Pro Ser
 1 5 10 15
 Ser Cys Ile Gln Glu Thr Tyr Asn Glu Glu Ser Cys Ser Thr Val Thr
 20 25 30
 Arg Gly Tyr Lys Ser Val Leu Arg Thr Gly Trp Tyr Thr Asn Val Phe
 35 40 45
 Asn Leu Glu Ile Gly Asn Val Glu Asn Ile Thr Cys Asn Asp Gly Pro
 50 55 60
 Ser Leu Ile Asp Thr Glu Leu Val Leu Thr Lys Asn Ala Leu Arg Glu
 65 70 75 80
 Leu Lys Thr Val Ser Ala Asp Gln Val Ala Lys Glu Ser Arg Leu Ser
 85 90 95
 Ser Pro Arg Arg Arg Arg Phe Val Leu Gly Ala Ile Ala Leu Gly Val
 100 105 110
 Ala Thr Ala Ala Ala Val Thr Ala Gly Val Ala Leu Ala Lys Thr Ile
 115 120 125
 Arg Leu Glu Gly Glu Val Lys Ala Ile Lys Asn Ala Leu Arg Asn Thr
 130 135 140
 Asn Glu Ala Val Ser Thr Leu Gly Asn Gly Val Arg Val Leu Ala Thr
 145 150 155 160
 Ala Val Asn Asp Leu Lys Glu Phe Ile Ser Lys Lys Leu Thr Pro Ala
 165 170 175
 Ile Asn Gln Asn Lys Cys Asn Ile Ala Asp Ile Lys Met Ala Ile Ser
 180 185 190
 Phe Gly Gln Asn Asn Arg Arg Phe Leu Asn Val Val Arg Gln Phe Ser
 195 200 205
 Asp Ser Ala Gly Ile Thr Ser Ala Val Ser Leu Asp Leu Met Thr Asp
 210 215 220
 Asp Glu Leu Val Arg Ala Ile Asn Arg Met Pro Thr Ser Ser Gly Gln
 225 230 235 240
 Ile Ser Leu Met Leu Asn Asn Arg Ala Met Val Arg Arg Lys Gly Phe
 245 250 255
 Gly Ile Leu Ile Gly Val Tyr Asp Gly Thr Val Val Tyr Met Val Gln
 260 265 270
 Leu Pro Ile Phe Gly Val Ile Glu Thr Pro Cys Trp Arg Val Val Ala
 275 280 285
 Ala Pro Leu Cys Arg Lys Glu Lys Gly Asn Tyr Ala Cys Ile Leu Arg
 290 295 300
 Glu Asp Gln Gly Trp Tyr Cys Thr Asn Ala Gly Ser Thr Ala Tyr Tyr
 305 310 315 320
 Pro Asn Lys Asp Asp Cys Glu Val Arg Asp Asp Tyr Val Phe Cys Asp
 325 330 335
 Thr Ala Ala Gly Ile Asn Val Ala Leu Glu Val Glu Gln Cys Asn Tyr

```

          340          345          350
Asn Ile Ser Thr Ser Lys Tyr Pro Cys Lys Val Ser Thr Gly Arg His
          355          360          365
Pro Val Ser Met Val Ala Leu Thr Pro Leu Gly Gly Leu Val Ser Cys
          370          375          380
Tyr Glu Ser Val Ser Cys Ser Ile Gly Ser Asn Lys Val Gly Ile Ile
385          390          395          400
Lys Gln Leu Gly Lys Gly Cys Thr His Ile Pro Asn Asn Glu Ala Asp
          405          410          415
Thr Ile Thr Ile Asp Asn Thr Val Tyr Gln Leu Ser Lys Val Val Gly
          420          425          430
Glu Gln Arg Thr Ile Lys Gly Ala Pro Val Val Asn Asn Phe Asn Pro
          435          440          445
Ile Leu Phe Pro Glu Asp Gln Phe Asn Val Ala Leu Asp Gln Val Phe
          450          455          460

Glu Ser Ile Asp Arg Ser Gln Asp Leu Ile Asp Lys Ser Asn Asp Leu
465          470          475          480
Leu Gly Ala Asp Ala Lys Ser Lys Ala Gly Ile Ala Ile Ala Ile Val
          485          490          495
Val Leu Val Ile Leu Gly Ile Phe Phe Leu Leu Ala Val Ile Tyr Tyr
          500          505          510
Cys Ser Arg Val Arg Lys Thr Lys Pro Lys His Asp Tyr Pro Ala Thr
          515          520          525
Thr Gly His Ser Ser Met Ala Tyr Val Ser
          530          535

```

<210> 13

<211> 537

<212> PRT

<213> Avian penumovirus

<220>

<223> Avian pneumovirus fusion glycoprotein (F) gene,
complete cds

<400> 13

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Met Ser Trp Lys Val Val Leu Leu Leu Val Leu Leu Ala Thr Pro Thr
  1          5          10          15
Gly Gly Leu Glu Glu Ser Tyr Leu Glu Glu Ser Cys Ser Thr Val Thr
          20          25          30
Arg Gly Tyr Leu Ser Val Leu Arg Thr Gly Trp Tyr Thr Asn Val Phe
          35          40          45
Thr Leu Glu Val Gly Asp Val Glu Asn Leu Thr Cys Thr Asp Gly Pro
          50          55          60
Ser Leu Ile Arg Thr Glu Leu Glu Leu Thr Lys Asn Ala Leu Glu Glu
          65          70          75          80
Leu Lys Thr Val Ser Ala Asp Gln Leu Ala Lys Glu Ala Arg Ile Met
          85          90          95
Ser Pro Arg Lys Ala Arg Phe Val Leu Gly Ala Ile Ala Leu Gly Val
          100          105          110
Ala Thr Ala Ala Val Thr Ala Gly Val Ala Ile Ala Lys Thr Ile
          115          120          125
Arg Leu Glu Gly Glu Val Ala Ala Ile Lys Gly Ala Leu Arg Lys Thr
          130          135          140
Asn Glu Ala Val Ser Thr Leu Gly Asn Gly Val Arg Val Leu Ala Thr
          145          150          155          160
Ala Val Asn Asp Leu Lys Asp Phe Ile Ser Lys Lys Leu Thr Pro Ala
          165          170          175
Ile Asn Arg Asn Lys Cys Asp Ile Ser Asp Leu Lys Met Ala Val Ser
          180          185          190

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Phe Gly Gln Tyr Asn Arg Arg Phe Leu Asn Val Val Arg Gln Phe Ser
 195 200 205
 Asp Asn Ala Gly Ile Thr Pro Ala Ile Ser Leu Asp Leu Met Thr Asp
 210 215 220
 Ala Glu Leu Val Arg Ala Val Ser Asn Met Pro Thr Ser Ser Gly Gln
 225 230 235 240
 Ile Asn Leu Met Leu Glu Asn Arg Ala Met Val Arg Arg Lys Gly Phe
 245 250 255
 Gly Ile Leu Ile Gly Val Tyr Gly Ser Ser Val Val Tyr Ile Val Gln
 260 265 270
 Leu Pro Ile Phe Gly Val Ile Asp Thr Pro Cys Trp Lys Val Lys Ala
 275 280 285
 Ala Pro Leu Cys Ser Gly Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg
 290 295 300
 Glu Asp Gln Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr
 305 310 315 320

 Pro Asn Glu Glu Asp Cys Glu Val Arg Ser Asp His Val Phe Cys Asp
 325 330 335
 Thr Ala Ala Gly Ile Asn Val Ala Lys Glu Ser Glu Glu Cys Asn Arg
 340 345 350
 Asn Ile Ser Thr Thr Lys Tyr Pro Cys Lys Val Ser Thr Gly Arg His
 355 360 365
 Pro Ile Ser Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys
 370 375 380
 Tyr Asp Gly Met Ser Cys Ser Ile Gly Ser Asn Lys Val Gly Ile Ile
 385 390 395 400
 Arg Pro Leu Gly Lys Gly Cys Ser Tyr Ile Ser Asn Gln Asp Ala Asp
 405 410 415
 Thr Val Thr Ile Asp Asn Thr Val Tyr Gln Leu Ser Lys Val Glu Gly
 420 425 430
 Glu Gln His Thr Ile Lys Gly Lys Pro Val Ser Ser Asn Phe Asp Pro
 435 440 445
 Ile Glu Phe Pro Glu Asp Gln Phe Asn Ile Ala Leu Asp Gln Val Phe
 450 455 460
 Glu Ser Val Glu Lys Ser Gln Asn Leu Ile Asp Gln Ser Asn Lys Ile
 465 470 475 480
 Leu Asp Ser Ile Glu Lys Gly Asn Ala Gly Phe Val Ile Val Ile Val
 485 490 495
 Leu Ile Val Leu Leu Met Leu Ala Ala Val Gly Val Gly Val Phe Phe
 500 505 510
 Val Val Lys Lys Arg Lys Ala Ala Pro Lys Phe Pro Met Glu Met Asn
 515 520 525
 Gly Val Asn Asn Lys Gly Phe Ile Pro
 530 535

<210> 14

<211> 1193

<212> DNA

<213> rhinotracheitis virus

<220>

<221> CDS

<222> (16)...(1191)

 <223> Turkey rhinotracheitis virus (strain CVL14/1)
 attachment protien (G) mRNA, complete cds

<400> 14

 gggacaagta tctctatggg gtccaaacta tatatggctc agggcaccag tgcatatcaa 60
 actgcagtgg gggtctggct ggacatcggg aggaggtaca tattggctat agtcctatca 120
 gctttcgggc tgacctgcac agtcactatt gcactcactg ttagcgctcat agttgaacag 180

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tcagtgttag aggagtgcag aaactacaat ggaggagata gagattggtg gtcaaccacc 240
caggagcagc caactactgc accaagtgcg actccagcag gaaattatgg aggattacaa 300
acggctcgaa caagaaagtc tgaaagctgt ttgcatgtgc aaatttctta tggatgatatg 360
tatagccgca gtgatactgt actgggtggt tttgattgta tgggcttatt ggttctttgc 420
aaatcaggac caatttgtca gcgagataat caagttgacc caacagccct ctgccattgc 480
agggtagatc tttcaagtgt ggactgctgc aagggtgaaca agattagcac taacagcagc 540
accacctctg agccccagaa gaccaacccg gcatggccta gccaagacaa cacagactcc 600
gatccaaatc cccaaggcat aaccaccagc acagccactc tgctctcaac aagtctgggc 660
ctcatgctca catcgaagac tgggacacac aaatcagggc cccccaagc cttgccgggg 720
agcaacacca acggaataac aaccacagac cgagaaccag ggcccacaaa ccaaccaaat 780
tcaaccacca atgggcaaca caataaacac acccaacgaa tgacaccccc gccaaagtcac 840
gacaacacaa gaaccatcct ccagcacaca acaccctggg aaaagacatt cagtacatac 900
aagcccacac actctccgac caacgaatca gatcaatccc tccccacaa tcaaacacagc 960
atcaactgtg aacattttga cccccaaggc aaggaaaaaa tctgctacag agtaggttct 1020
tacaactcca atattacaaa gcaatgcaga attgatgtgc ctttgtgttc cacttatagc 1080
acagtgtgca tgaaaacata ctataccgaa ccattcaact gttggaggcg tatctggcgt 1140
tgcttgtgtg atgacggagt tgggtctggt gagtgggtgt gcactagtta act 1193

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<210> 15

<211> 1260

<212> DNA

<213> rhinotracheitis virus

<220>

<221> CDS

<222> (16)...(1260)

<223> Turkey rhinotracheitis virus (strain 6574)
attachment protein (G), complete cds

<400> 15

```

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<211> 391

<212> PRT

<213> Turkey rhinotracheitis virus

<220>

<223> Turkey rhinotracheitis virus (strain CVL14/1)
attachment protien (G) mRNA, complete cds

<400> 16

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Val Leu Ser Ala Phe Gly Leu Thr Cys Thr Val Thr Ile Ala Leu Thr
          35          40          45
Val Ser Val Ile Val Glu Gln Ser Val Leu Glu Glu Cys Arg Asn Tyr
          50          55          60
Asn Gly Gly Asp Arg Asp Trp Trp Ser Thr Thr Gln Glu Gln Pro Thr
65          70          75          80
Thr Ala Pro Ser Ala Thr Pro Ala Gly Asn Tyr Gly Gly Leu Gln Thr
          85          90          95
Ala Arg Thr Arg Lys Ser Glu Ser Cys Leu His Val Gln Ile Ser Tyr
          100          105          110
Gly Asp Met Tyr Ser Arg Ser Asp Thr Val Leu Gly Gly Phe Asp Cys
          115          120          125
Met Gly Leu Leu Val Leu Cys Lys Ser Gly Pro Ile Cys Gln Arg Asp
          130          135          140
Asn Gln Val Asp Pro Thr Ala Leu Cys His Cys Arg Val Asp Leu Ser
145          150          155          160
Ser Val Asp Cys Cys Lys Val Asn Lys Ile Ser Thr Asn Ser Ser Thr
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Thr Ser Glu Pro Gln Lys Thr Asn Pro Ala Trp Pro Ser Gln Asp Asn
          180          185          190
Thr Asp Ser Asp Pro Asn Pro Gln Gly Ile Thr Thr Ser Thr Ala Thr
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Leu Leu Ser Thr Ser Leu Gly Leu Met Leu Thr Ser Lys Thr Gly Thr
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His Lys Ser Gly Pro Pro Gln Ala Leu Pro Gly Ser Asn Thr Asn Gly
225          230          235          240
Lys Thr Thr Thr Asp Arg Glu Pro Gly Pro Thr Asn Gln Pro Asn Ser
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Thr Thr Asn Gly Gln His Asn Lys His Thr Gln Arg Met Thr Pro Pro
          260          265          270
Pro Ser His Asp Asn Thr Arg Thr Ile Leu Gln His Thr Thr Pro Trp
          275          280          285
Glu Lys Thr Phe Ser Thr Tyr Lys Pro Thr His Ser Pro Thr Asn Glu
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Ser Asp Gln Ser Leu Pro Thr Thr Gln Asn Ser Ile Asn Cys Glu His
305          310          315          320
Phe Asp Pro Gln Gly Lys Glu Lys Ile Cys Tyr Arg Val Gly Ser Tyr
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Asn Ser Asn Ile Thr Lys Gln Cys Arg Ile Asp Val Pro Leu Cys Ser
          340          345          350
Thr Tyr Ser Thr Val Cys Met Lys Thr Tyr Tyr Thr Glu Pro Phe Asn
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Val Glu Trp Cys Cys Thr Ser
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<211> 414

<212> PRT

<213> rhinotracheitis virus

<220>

<223> Turkey rhinotracheitis virus (strain 6574)
attachment protein (G), complete cds

<400> 17

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Val Leu Ser Ala Leu Gly Leu Thr Leu Thr Ser Thr Ile Val Ile Ser
          35           40           45
Ile Cys Ile Ser Val Glu Gln Val Lys Leu Arg Gln Cys Val Asp Thr
          50           55           60
Tyr Trp Ala Glu Asn Gly Ser Leu His Pro Gly Gln Ser Thr Glu Asn
65          70          75          80
Thr Ser Thr Arg Gly Lys Thr Thr Thr Lys Asp Pro Arg Arg Leu Gln
          85          90          95
Ala Thr Gly Ala Gly Lys Phe Glu Ser Cys Gly Tyr Val Gln Val Val
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Cys Leu Gly Leu Leu Ala Leu Cys Glu Ser Gly Pro Ile Cys Gln Gly
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Asp Thr Trp Ser Glu Asp Gly Asn Phe Cys Arg Cys Thr Phe Ser Ser
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Ser Asp Arg Ala Ser Lys Glu His Asn Pro Ser Gln Gly Glu Gln Pro
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Arg Arg Gly Pro Thr Ser Ser Lys Thr Thr Ile Ala Ser Thr Pro Ser
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Thr Glu Asp Thr Ala Lys Pro Thr Ile Ser Lys Pro Lys Leu Thr Ile
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Thr Pro Ser His Lys Thr Asn Thr Arg Gly Thr Ser Lys Thr Thr Asp
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Gln Arg Pro Arg Thr Gly Pro Thr Pro Glu Arg Pro Arg Gln Thr His
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Tyr Gln Val Gly Thr Tyr Asn Pro Ser Gln Ser Gly Thr Cys Asn Ile
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Glu Val Pro Lys Cys Ser Thr Tyr Gly His Ala Cys Met Ala Thr Leu
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Tyr Asp Thr Pro Phe Asn Cys Trp Arg Arg Thr Arg Arg Cys Ile Cys
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<211> 13294

<212> DNA

<213> human metapneumo virus

<220>

<221> misc_feature

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<223> human MPV protein

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<400> 87

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atggaggtga aagtggagaa cattcgaaca atagatatgc tcaaagcaag agtaaaaaaat 60
cgtgtggcac gcagcaaattg ctttaaaaaat gcctcttttg tcctcatagg aataactaca 120
ttgagtattg ccctcaatat ctatctgata ataaactata aaatgcaaaa aaacacatct 180
gaatcagaac atcacaccag ctcacacccc atggaatcca gcagagaaac tccaacgggtc 240

```



```

ccccacagata attcagacac caactcaagc ccacaacatc caactcaaca gtccacagaa 300
ggctccacac tctactttgc agcctcagca aactcaccag agacagaacc aacatcaaca 360
ccagacacaa cagaccgccc gcccttcgtc gacacacaca caacaccacc aagcgcaagc 420
agaacaaaga caagtccggc agtccacaca aaaaacaacc caaggataag ctccagaaca 480
cattctccac catgggcaac gacaaggacg gcacgcagaa ccaccactct cgcacaaagc 540
agcacaagaa agagaccgtc cacagcatca gtccaaccgc acatcagcgc aacaaccac 600
aaaaacgaag aagcaagtcc agcgagccca caaacatctg caagcacaac aagaacacaa 660
aggaaaagcg tggaggccaa cacatcaaca acatacaacc aaactagtta acaaaaaata 720
caaaataact ctaagataaa ccatgcagac accaacaatg gagaagtcaa aagacaattc 780
acaatctccc caaaaaggca acaacaccat attagctctg cccaaatctc cctggaaaaa 840
acactcgccc atataccaaa aataccacaa ccacccaag aaaaaactg ggcaaaacaa 900
cacccaa 907

```

<210> 88

<211> 907

<212> DNA

<213> human metapneumo virus

<400> 88

```

atggaggtga aagtggagaa cattcgaaca atagatatgc tcaaagcaag agtaaaaaat 60
cgtgtggcac gcagcaaatg ctttaaaaaat gcctcttttg tctcatagg aataactaca 120
ttgagtattg ccctcaatat ctatctgata ataaactata aaatgcaaaa aaacacatct 180
gaatcagaac atcacaccag ctcatcacc atggaatcca gcagagaaac tccaacgggtc 240
ccccacagata attcagacac caactcaagc ccacaacatc caactcaaca gtccacagaa 300
ggctccacac tctactttgc agcctcagca agctcaccag agacagaacc aacatcaaca 360
ccagacacaa cagaccgccc gcccttcgtc gacacacaca caacaccacc aagcgcaagc 420
agaacaaaga caagtccggc agtccacaca aaaaacaacc caaggataag ctccagaaca 480
cattctccac catgggcaac gacaaggacg gcacgcagaa ccaccactct cgcacaaagc 540
agcacaagaa agagaccgtc cacagcatca gtccaaccgc acatcagcgc aacaaccac 600
aaaaacgaag aagcaagtcc agcgagccca caaacatctg caagcacaac aagaacacaa 660
aggaaaagcg tggaggccaa cacatcaaca acatacaacc aaactagtta acaaaaaata 720
caaaataact ctaagataaa ccatgcagac accaacaatg gagaagtcaa aagacaattc 780
acaatctccc caaaaaggca acaacaccat attagctctg cccaaatctc cctggaaaaa 840
acactcgccc atataccaaa aataccacaa ccacccaag aaaaaactg ggcaaaacaa 900
cacccaa 907

```

<210> 89

<211> 907

<212> DNA

<213> human metapneumo virus

<400> 89

```

atggaggtga aagtggagaa cattcgaaca atagatatgc tcaaagcaag agtgaaaaat 60
cgtgtggcac gcagcaaatg ctttaaaaaat gcctctttga tcctaataagg aataactaca 120
ttgagtatag ccctcaatat ctatctgata ataaactata caatgcaaga aaacacatcc 180
gaatcagaac atcacaccag ctcatcacc atggaatcca gcagggaaac tccaacgggtc 240
cccatagaca actcagacac caatccaggc tcacagtatc caactcaaca gtccacagaa 300
gactccacac tccactctgc agcttcagca agctcaccag agacagaacc aacatcaaca 360
ccagacacaa caagccgccc gcccttcgtc gacacacaca caacaccacc aagtgcgaagc 420
aggacaagga caagtccggc agtccacaca aaaaacaatc caagggtaag cccagaaca 480
cattccccac catgggcaat gacaaggacg gtccgcggaa ccaccactct cgcacaaagc 540
agcacaagaa aaagactgtc tacagcatca gtccaaccgc acagcagcgc aacaaccac 600
aaacacgaag aaacaagccc agtgagccca caaacatctg caagcacagc aagaccacaa 660
aggaagggca tggaggccag cacatcaaca acatacaacc aaactagtta acaaaaaata 720
caaaataact ctaagataaa ccatgtagac accaacaatt gagaagccaa aaggcaattc 780
acaatctccc aaaaaagcaa caacaccata ttagctcgcg ttaaattctc ctgaaaaaaa 840
cactcaccca tataccaact ataccacaac catcccaaga aaaaaggctg ggcaaaacaa 900
cacccaa 907

```

<210> 90

<211> 908

<212> DNA

<213> human metapneumo virus

<400> 90

```

atggaggtga aagtggagaa cattcgaaca atagatatgc tcaaagcaag agtgaaaaat 60
cgtgtggcac gcagcaaatg ctttaaaaaat gcctctttga tcctaataagg aataactaca 120
ttgagtatag ccttcaatat ctatctgata ataaactata caatgcaaga aaacacatcc 180
gaatcagaac atcacaccag ttcatacccc atggaatcca gcagggaac tccaacgggtc 240
cctatggaca actcagacac caatccaggc tcacagtatc caactcaaca gtccacagaa 300
ggctccacac tccactttgc agcctcagca agctcaccag agacagaacc aacatcaaca 360
ccagacacaa caagccgccc gcccttcgtc gacacacaca caacaccatc aagtgaagc 420
agaacaaaga caagtccggc agtccacaca aaaaacaatc taaggataag cccagaaca 480
cattccccac catgggcaat gacaaggacg gtccgtggaa ccaccactct ccgcacaagc 540
agcataagaa aaagaccgtc cacagcatca gtccaacctg acagcagcgc aacaaccac 600
aaacacgaag aagcaagccc agtgagcccg caagcatctg caagcacagc aagaccacaa 660
aggaagggca tggaggccag cacatcaaca acatacaacc aaactagtta acaaaaaata 720
taaaataact ctaagataaa ccatgtagac accaacaatt gagaagccaa aaggcaattc 780
acaatctccc caaaaaggca acaacaccat attagctccg cttaaatctc cctggaaaaa 840
acactcgccc atataccaac tataccacaa ccatcccaag gaaaaaagct gggtaaaaaa 900
acacccaa                                     908

```

<210> 91

<211> 908

<212> DNA

<213> human metapneumo virus

<400> 91

```

atggaggtga aagtggagaa cattcgaaca atagatatgc tcaaagcaag agtgaaaaat 60
cgtgtggcac gcagcaaatg ctttaaaaaat gcctctttga tcctaataagg aataactaca 120
ttgagtatag ccttcaatat ctatctgata ataaactata caatgcaaga aaacacatcc 180
gaatcagaac atcacaccag ctcatcacc atggaatcca gcagagaaac tccaacgggtc 240
cctatggaca actcagacac caatccaggc tcacagtatc caactcaaca gtccacagaa 300
ggctccacac tccactttgc agcctcagca agctcaccag agacagaacc aacatcaaca 360
ccagacacaa caagccgccc gcccttcgtc gacacacaca caacaccatc aagtgaagc 420
agaataagga caagtccggc agtccacaca aaaaacaatc taaggataag cccagaaca 480
cattccccac catgggcaat gacaaggacg gtccgtggaa ccaccactct ccgcacaagc 540
agcataagaa aaagaccgtc cacagcatca gtccaacctg acagcagcgc aacaaccac 600
aaacacgaag aagcaagccc agtgagcccg caagcatctg caagcacagc aagaccacaa 660
aggaagggca tggaggccag cacatcaaca acatacaacc aaactagtta acaaaaaata 720
tacaataact ctaagataaa ccatgtagac accaacaatt gagaagccaa aaggcaattc 780
acaatctccc caaaaaggca acaacaccat attagctccg cttaagtctc cctggaaaaa 840
acactcgccc atataccaac tataccacaa ccatcccaag aaaaaaagct gggcaaaaaa 900
acacccaa                                     908

```

<210> 92

<211> 888

<212> DNA

<213> human metapneumo virus

<400> 92

```

atggaggtga aagtagagaa cattcgagca atagacatgc tcaaagcaag agtgaaaaat 60
cgtgtggcac gtagcaaatg ctttaaaaaat gcttctttta tcctcatagg aataactaca 120
ctgagtatag ctctcaatat ctatctgata ataaactata caatacaaaa aaccacatcc 180
gaatcagaac accacaccag ctcaccaccc acagaaccca acaagggaagc ttcaacaatc 240
tccacagaca acccagacat caatccaagc tcacagcatc caactcaaca gtccacagaa 300
aaccacacac tcaaccccgcc agcatcagcg agcccatcag aaacagaacc agcatcaaca 360
ccagacacaa caaacccgct gtcctccgta gacaggtcca cagcacaacc aagtgaagc 420
agaacaaaga caaaaccgac agtccacaca atcaacaacc caaacacagc ttccagtaca 480
caatccccac cacggacaac aacgaaggca atccgcagag ccaccacttt ccgcatgagc 540
agcacaggaa aaagaccaac cacaacatta gtccagtcgg acagcagcac cacaacccaa 600
aatcatgaag aaacaggttc agcgaaccca caggcgtctg caagcacaat gcaaaactag 660

```

```

cacaccaata atataaaaacc aaatttagtta acaaaaaaatg cgagatagct ctaaagcaaa 720
acatgtaggt accaacaatc aagaaaccaa aagacaactc acaatctccc taaaacagca 780
acgacaccat gtcagctttg ctcaaattctc tctgggagaa acttctaccc acatactaac 840
aacatcacia ccatctcaag aaaagaaact gggcaaaaaca gcatccaa 888

```

<210> 93

<211> 888

<212> DNA

<213> human metapneumo virus

<400> 93

```

atggaggtga aagtagagaa cattcgagca atagacatgc tcaaagcaag agtgaaaaat 60
cgtgtggcac gcagcaaattg ctttaaaaaat gcttctttaa tcctcatagg aataactaca 120
ctgagtatag ccctcaatat ctatctgatc ataaactaca caatacaaaa aaccacatct 180
gaatcagaac accacactag ctcaccaccc acagaatcca acaaagaaac ttcaacaatc 240
cccatagaca acccagacat caatccaaac tcacagcatc caaccacaac gtccacagaa 300
agccccacac tcaaccccgcc agcctcgggtg agcccatcag aaacagaacc agcatcaaca 360
ccagacacaa caaacccgctt gtcctccgta gacagatcca caacacaacc aagtgaagc 420
agaacaaaga caaaaccaac agtccacaca aaaaacaatc caagtacagt ttccagaaca 480
caatccccac tacgggcaac aacgaaggcg gtcctcagag ccaccgcttt ccgcacgagc 540
agcacaagaa aaagaccaac cacaacatca gtccagtctg acagcagcac cacaacccaa 600
aatcatgaag aaacaagttc agcgaaccca caggcatctg caagcacaat gcaaagccag 660
cacaccaaca acataaaaacc aaatttagtta acaaaaaata cgagatagct ctaaagttaa 720
acatgtaggt accaacaatc aaggaatcaa aagacaactc acaatctccc taaaacagca 780
acaacatcat gtcagttttg ctcaaattctc cctgggagaa actttcgccc acatactaac 840
aacatcacia ccatctcaag aaaagaaact gggcaaaaaca gcacccaa 888

```

<210> 94

<211> 888

<212> DNA

<213> human metapneumo virus

<400> 94

```

atggaggtga aagtagagaa catccgagca gtagacatgc tcaaagcaag agtcaaaaaat 60
cgtgtggcac gcagcaaattg ctttaaaaaat gcctccttaa tcctcgtagg aataactaca 120
ctgagcatag ccctcaatat ctatctgatc gtaaactaca caatacaaaa aaccacatcc 180
gaatcagaac accacaccag ctcacacccc acagaatcca acaaaggaac ttcaacaatc 240
cccacagaca acccagacat caatccaaat tcacaacatc caactcaaca gtccacagaa 300
agccccacac tcaaacccgct agcctcgggtg agcccatcag aaacagaacc agcatcaaca 360
ccagacacaa caaacccgctt gtcctccgca gacagatcca caacacaacc aagtgaagc 420
agaacaaaga caaagctgac agtccacaca aaaaacaacc taagtacagc ctccagaaca 480
caatcaccac cacgggcaac aacgaaggcg gtcctcagag acaccgcttt ccacacgagc 540
agcacaggaa aaagaccaac cacaacatca gtccagtctg gcagcagcac cacaactcaa 600
aatcatgaag aaacaagttc atcgaaccca caggcatctg caagcacaat gcaagaccag 660
gacaccaaca atacaaaaca aaatttagtta acaaaaaata caagatagct ctaaagttaa 720
acatgtaggt accaacagta aagaaatcaa aagacaactc acaatctccc caaacagca 780
acaacatcat gtcagcttcg ctcaaattctc cctgggagaa actctcgccc acatactaac 840
aacatcacia ctatctcaag aaaagaaact gggcaaaaaa acactcaa 888

```

<210> 95

<211> 887

<212> DNA

<213> human metapneumo virus

<400> 95

```

atggaggtga aagtagagaa catccgagca gtagacatgc tcaaagcaag agttaaaaaat 60
cgtgtggcac gcagcaaattg ctttaaaaaat gcctctttaa tcctcgtagg aataactaca 120
ctgagtatag ccctcaatat ctatctgatc gtaaactaca caatacaaaa aaccacatcc 180
gaatcagaac accacactag ctcacacccc acagaatcca acaaaggaac ttcaacaatc 240
ccacagacaa cccagacatc aatccaaatt cacaacatcc aactcaacag tccacagaaa 300
gccccacact caacaccgca gcctcgggtga gcccatcaga aacagaacca gcatcaacac 360

```

```

cagacacaac aaaccgcctg tctccgcgag acagatccac aacacaacca agtgaaagca 420
gaacaaagac aaagctgaca gtccacacaa aaaacaacct aagtacagcc tccagaacac 480
aatcaccacc acgggcaaca acgaaggcgg tctctagaga caccgccttc cacacgagca 540
gcacaggaaa aagaccaacc acaacatcag tccagtctgg cagcagcacc acaactcaaa 600
atcatgaaga aacaagttca tcgaaccac aggcattctgc aagcacaatg caagaccagg 660
acaccaacaa taaaaaacia aattagttaa caaaaaatag aagatagctc taaagtaaaa 720
catgtaggta ccaacagtaa agaaatcaaa agacaactca taatctcccc aaaacagcaa 780
caacatcatg tcagcttcgc tcaaattctc ctgggagaaa ctctcgccca catactaaca 840
acatcacaac tatctcaaga aaagaaactg ggcaaaaaaa cactcaa 887

```

<210> 96

<211> 888

<212> DNA

<213> human metapneumo virus

<400> 96

```

atggaggtga aagtagagaa cattcgagca atagacatgc tcaaagcaag aatgaaaaat 60
cgtgtggcac gcagcaaatg ctttaaaaat gcttctttta tctcatagg aataactact 120
ctgagtatag ccctcaatat ctatctgac ataaactaca caatacaaaa aaccacatct 180
gaatcagaac accacactag ctaccacccc acagaatcca acaaagaaac ttcaacaatc 240
cctatagaca acccagacat caatccaaac tcacagcatc caactcaaca gtccacagaa 300
agcctcacac tcaaccccg cgcctcgggt agcccatcag aaacagaacc agcatcaaca 360
ccagacacaa caaacgcct gtctccgta gacagatcca caacacaacc aagtgaagc 420
agaacaaaga caaaactgac agtccacaaa aaaaacatcc caagtacagt ctctagaaca 480
caatcctcaa tacgggcaac aacgaaggcg gtccctcagag ccaccgcctt tcgcacgagc 540
agcacaggag aaagaccaac tacaacatca gtccagtctg acagcagcac cacaacccaa 600
aatcatgaag aaacaggttc agcgaaccca caggcatctg caagcacaat gcaaaactag 660
cacaccaaca ttgtaaaacc aaattagtta acaaaaaata tgaaatagct ctaaagtaaa 720
acatgtagggt gctaacaatc aagaaatcaa aagacatctc ataattctctc caaaacagca 780
acaacatcat gtcaactttg ctcaaattct cctgggagaa actttcgccc ccatactgac 840
aacatcacaa tcattctcaag aaaagaaact gggcaaaaac gcaccaa 888

```

<210> 97

<211> 888

<212> DNA

<213> human metapneumo virus

<400> 97

```

atggaggtga aagtagagaa cattcgagca atagacatgc tcaaagcaag agtgaaaaat 60
cgtgtggcac gcagcaaatg ctttaaaaat gcttctttta tctcatagg aataactact 120
ctgagtatag ccctcaacat ctatctgac ataaactaca caatacaaaa aaccacatct 180
gaatcagaac accacactag ctaccacccc acagaatcta acaaagaaac ttcaacaatc 240
tctatagaca acccagacat caatccaaac tcacagcatc caactcaaca gtccacagaa 300
agcctcacac tcagccccc agcctcgggt agcccatcag aaacagaacc agcatcaaca 360
tcagacacaa caagccgcct gtctccgta gacagatcca caacacaacc aagtgaagc 420
agagcaagga caaaaccgac agtccacaag aaaaacatcc caagtacagt ttctagaaca 480
caatccccac tacgggcaac aacgaaggcg gtccctcagag ccaccgcctt tcgcacgagc 540
agcacaggag agggaccaac cacaacatcg gtccagtctg acagcagcac cacaacccaa 600
aatcatgaag aaacaggttc agcgaaccca caggcatctg caagcacaat gcaaaactag 660
cacaccaaca ttgtaaaacc aaattagtta acaaaaaata tgaaatagtt ctaaagtaaa 720
acatgtagggt gctaacaatc aagaaatcaa aagacaactc ataattctccc taaaacagca 780
acaacatcat gtcaactttg ctcaaattct cctgggagaa actttcgccc ccatactgac 840
aacatcacaa tcattctcaag aaaagaaact gggcaaaaac gcaccaa 888

```

<210> 98

<211> 888

<212> DNA

<213> human metapneumo virus

<400> 98

```

atggaggtga aagtagagaa cattcgagca atagacatgc tcaaagcaag agtgaaaaat 60

```

```

cgtgtggcac gtagcaaatg ctttaaaaaat gcttcttttaa tcctcatagg aataactaca 120
ctgagtatag ctctcaatat ctatctgatac ataaactaca caatacaaaa aaccacatct 180
gaatcagaac accacaccag ctcaccaccc acagaatcca acaaggaagc ttcaacaatc 240
tccacagaca atccagacat caatccaaac tcacagcatc caactcaaca gtccacagaa 300
aaccccacac taaaccccg cgcagcatcg agctcatcag aaacagaacc agcatcaaca 360
ccagacacaa caaacccgct gtcctccgta gacagggtcca cagcacaacc aagtgaagc 420
agaacaaaga caaacccgac agtccacaca agaaacaacc caagcacagc ttccagcaca 480
caatccccac cacgggtaac aacgaaggca atcctcagag ccaccgtctt ccgcatgagc 540
agcacaggaa aaagaccagc cacaacatta gtccagtccg acagcagcac cacaacccaa 600
aatcatgaag aaacagggtc agcaaaactc caggcatctg caagcacaat gcaaaaactag 660
cactccaaca atataaaac aaattagtta acaaaaaata cgagatagct cttaaagtaaa 720
acatgtaggc accaacaatc aggaatttaa aagacaactc acaacctccc taaaacagca 780
acgacaccat gtcaactttg ctcaaacttc tctggggagaa acttttgccc acataactaa 840
aacatcacia tcattctcaag aaaagaaact gggcaaaaaca gcatccaa 888

```

<210> 99

<211> 888

<212> DNA

<213> human metapneumo virus

<400> 99

```

atggagggtga aagtagagaa cattcgagca atagacatgc tcaaagcaag agtgaaaaat 60
cgtgtggcac gcagcaaatg ctttaaaaaat gcttcttttaa tcctcatagg aataactact 120
ctgagtatag ccttcaatat ctatctgatac ataaactaca caatacaaaa aaccacatct 180
gaatcagaac accacactag ctcaccaccc acagaatcta acaagaaac ttcaacaatc 240
tctatagaca actcagacat caatccaaac tcacagcatc caactcaaca gtccacagaa 300
agcctcacac tcagccccac agcctcgggtg agcccatcag aaacagaacc agcatcaaca 360
tcagacacaa caaacccgct gtcctccgta gacagatcca caacacaacc aagtgaagc 420
agagcaagaa caaacccgac agtccacaag aaaaaacatcc caagtacagt ttctagaaca 480
caatccccac tacgggcaac aacgaaggcg gtcctcagag ccaccgcctt tcgcatgagc 540
agcacaggag agggaccaac cacaacatcg gtccagtctg acagcagcac cacaacccaa 600
aatcatgaag aaacagggtc agcgaaccca caggcatctg caagcacaat gcaaaaaccag 660
cacaccaaca ttgcaaaacc aaattagtta acaaaaaata tgaaatagtt cttaaagtaaa 720
acatgtaggc gccacaatc aagaaatcaa aagacaactc acaatctccc taaaacagca 780
acaacatcat gccaaactttg ctcaaacttc cctggggagaa accctcgccc ccatactgac 840
aacatcacia tcattctcaag aaaagaaact gggcaaaaaca gcaccaa 888

```

<210> 100

<211> 888

<212> DNA

<213> human metapneumo virus

<400> 100

```

atggagggtga aagtagagaa cattcgagca atagacatgc tcaaagcaag agtgaaaaat 60
cgtgtggcac gcagcaaatg ctttaaaaaat gcttcttttaa tcctcatagg aataactact 120
ctgagtatag ccttcaatat ctatctgatac ataaactaca caatacaaaa aaccacatct 180
gaatcagaac accacactag ctcaccaccc acagaatcta acaaggaac ttcaacaatc 240
cctatagaca acccagacat caatccaaac tcacagcatc caactcaaca gtccacagaa 300
agcctcacac tctacccccac atcctcgggtg agctcatcag aaacagaacc agcatcaaca 360
ccaggcataa caaacccgct gtcctttgta gacagatcca caacacaacc aagtgaagc 420
agaacaaaga caaacccgac agtccacaaa aaaaaacatct caagtacagt ttctagaaca 480
cagtccccac cacgggacaac agcgaaggcg gtccccagag ccaccgcctt tcgcatgagc 540
agcacaggag aaagaccaac cacaacacca gtccagcccg atagcagcac cacaacccaa 600
aatcatgaag aaacagggtc agcgaaccca caggcatccg caagcacaat gcaaaaaccag 660
cacaccaaca ttgcaagacc aaattagtta acaaaaaata tgaaatagct cttaaagtaaa 720
acatgtaggc gccacaatc aagaaatcaa aagataactc ataactcttc taaaacatca 780
acaacatcat gttaactttg ctcaaacttc tctggggagaa accttcgccc ccatactggc 840
aacatcacia tcattctcaag aaaagaaact gggcaaaaaca acaccaa 888

```

<210> 101

<211> 888

<212> DNA

<213> human metapneumo virus

<400> 101

```

atggaggtga aagtagagaa cattcgagca atagacatgc tcaaagcaag agtgaaaaat 60
cgtgtggcac gcagcaaata ctttaaaaaat gcttctttaa tcctcatagg aataactact 120
ctgagtatag ccctcaatat ctatctgata ataaactaca caatacaaaa aaccacatct 180
gaatcagaac accacactag ctcaccaccc acagaatcta acaaggaaac ttcaacaatc 240
cctatagaca acccagacat caatccaaac tcacagcatc caactcaaca gtccgcagaa 300
agcctcacac tctaccccac atcctcgggtg agctcatcag aaacagaacc agcatcaaca 360
ccaggcataa caaaccacct gtcctttgtg gacagatcca caacacaacc aagtgaagac 420
agaacaaaga caaacgggac agtccacaaa aaaaacatct caagtacagt ttctagaaca 480
cagtccccac cacggacaac agcgaaggcg gtccccagag ccaccgccct tcgcacgagc 540
agcacaggag aaagaccaac cacaacacca gtccagcccg atagcagcac cacaacacaa 600
aatcatgaag aaacaggctc agcgaaccca caggcatccg caagcacaat gcaaaaccag 660
cacaccaaca ttgcaagacc aaattagtta acaaaaaata tgaaatagct ctaaagtaaa 720
acatgtaggc gccacaatac aagaaatcaa aagataactc ataactcttc taaaacatca 780
acaacatcat gttaactttg ctcaaactct tctggggagaa accttcgccc ccatactggc 840
aacatcacaa tcactctcaag aaaagaaact gggcaaaaaca acaccaa 888

```

<210> 102

<211> 888

<212> DNA

<213> human metapneumo virus

<400> 102

```

atggaggtga aagtagagaa tattcgagca atagacatgc tcaaagcaag agtgaaaaat 60
cgtgtggcac gcagcaaata ctttaaaaaat gcttctttaa tcctcatagg aataactact 120
ctgagtatag ccctcaatat ctatctgata ataaactaca caatacaaaa aaccacatct 180
gaatcagaac accacactag ctcaccaccc acagaatcta acaaggaaac ttcaacaatc 240
cctatagaca acccagacat caatccaaac tcacagcatc caactcaaca gtccacagaa 300
agcctcacac tctaccccac atcctcgggtg agctcatcag aaacagaacc agcatcaaca 360
ccaggcataa caaaccacct gtcctttgtg gacagatcca caacacaacc aagtgaagac 420
agaacaaaga caaacgggac agtccacaaa aaaaacatct caagtacagt ttctagaaca 480
cagtccccac cacggacaac agcgaaggcg gtccccagag ccaccgccct tcgcacgagc 540
agcacaggag aaagaccaac cacaacacca gtccagcccg atagcagcac cacaacacaa 600
aatcatgaag aaacaggctc agcgaaccca caggcatccg caagcacaat gcaaaaccag 660
cacaccaaca ttgcaagacc aaattagtta acaaaaaata tgaaatagct ctaaagtaaa 720
acatgtaggc gccacaatac aagaaatcaa aagataactc ataactcttc taaaacatca 780
acaacatcat gttaactttg ctcaaactct tctggggagaa accttcgccc ccatactggc 840
aacatcacaa tcactctcaag aaaagaaact gggcaaaaaca acaccaa 888

```

<210> 103

<211> 888

<212> DNA

<213> human metapneumo virus

<400> 103

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atggaggtga aagtagagaa cattcgagca atagacatgc tcaaagcaag agtgaaaaat 60
cgtgtggcac gtagcaaata ctttaaaaaat gcttctttaa tcctcatagg aataactaca 120
ctgagcatag ccctcaatat ctatctgata ataaactaca caatacaaca aaccacatct 180
gaatcagaac accacaccag ctcaccaccc acagaatcca acaaggaaac ttcaacaatc 240
tccacagaca acccagacat caatccaaac tcacagcatc caactcaaca gtccacagaa 300
aaccacacac tcaaccacgc agcatcagcg agccatcag aaacagaatc agcatcaaca 360
ccagatacaa caaaccgcct gtcctccgta gacagggtcca cggtagaacc aagtgaagac 420
agaacaaaga caaaactgac agtccacaca agaaacaacc taagcacagc ctccagtaca 480
caatccccac cacggggaac aacgaaggca atccgcagag ccaccaccct ccgcatgagc 540
agcacaggaa gaagaccaac cacaacacta gtccagtcgg acagcagcac cacaacccaa 600
aatcatgaag aaacaggctc agcgaaccca caggcatctg caagcacaat gcaaaaccag 660
cacaccaaca atataaaacc aaattagtta acaaaaaata cgagatagct ctaaagtaaa 720
acatgtaggc accaacaatac aagaaaccaa aagataactc acaatcccc caaaacagca 780

```

```

acgacacccat gtcagctttg ctcaaactctc tctggggagaa acttttgccc acataactaac 840
aacatcacaa ccatctcaag aaaagaaact gggcaaaaca gcatccaa 888

```

<210> 104

<211> 888

<212> DNA

<213> human metapneumo virus

<400> 104

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atggagggtga aagtagagaa cattcgagca atagacatgc tcaaagcaag agtgaaaaat 60
cgtgtggcac gtagcaaatg ctttaaaaat gcttctttaa tcctcatagg aataactaca 120
ctgagcatag ccctcaatat ctatctgata ataaactaca caatacaaaa aaccacatct 180
gaatcagaac accacaccag ctaccacccc acagaatcca acaaggaagc ttcaacaatc 240
tccacagaca acccagacat caatccaaac tcacagcatc caactcaaca gtccacagaa 300
aacccccacac tcaaccacagc agcatcagcg agcccatcag aaacagaatc agcatcaaca 360
ccagatacaa caaaccgcct gtccctccgta gacagggtcca cggtagaacc aagtgaaaac 420
agaacaaaga caaaactgac agtccacaca agaaacaacc taagcacagc ctccagtaca 480
caatccccac caggggcaac aacgaaggca atccgcagag ccaccaccct ccgcatgagc 540
agcacaggaa gaagaccaac cacaacacta gtccagtccg acagcagcac cacaacccaa 600
aatcatgaag aaacaggctc agcgaaccga caggcatctg caagcacaat gcaaaaccag 660
cacaccaaca atataaaaacc aaattagtta acaaaaaata cgagatagct ctaaagtaaa 720
acatgtaggc accaacaatc aagaaaccaa aagataactc acaatcccc caaaacagca 780
acgacacccat gtcagctttg ctcaaactctc tctggggagaa acttttgccc acataactaac 840
aacatcacaa ccatctcaag aaaagaaact gggcaaaaca gcatccaa 888

```

<210> 105

<211> 901

<212> DNA

<213> human metapneumo virus

<400> 105

```

atggaagtaa gaggtagagaa cattcgagcg atagacatgt tcaaagcaaa gataaaaaaac 60
cgtataagaa gcagcagggtg ctatagaaat gctacactga tccttatttg actaacagcg 120
ttaagcatgg cacttaatat tttcctgata atcgatcatg caacattaag aaacatgata 180
aaaacagaaa actgtgctaa catgccgtcg gcagaaccaa gcaaaaagac cccaatgacc 240
tccacagcag gcccaaacac caaaccatc ccacagcaag caacacagtg gaccacagag 300
aactcaacat cccagtagc aaccacagag ggccatccat acacagggac aactcaaaaca 360
tcagacacaa cagctcccca gcaaacacaca cagcaccgct aaaatcaacc 420
aatgaacaga tcaccagac aaccacagag aaaaagacaa tcagagcaac aaccacaaaa 480
agggaaaaag gaaaagaaaa cacaaccaa accacaagca cagctgcaac ccaaacacac 540
aacaccacca accaaatcag aaatgcaagt gagacaatca caacatccga cagacccaga 600
actgacacca caaccacaa cagcgaacag acaaccggg caacagacc aagctcccca 660
ccacaccatg catagagagg tgcaaaaactc aaatgagcac aacacacaaa catcccatcc 720
aagtagttaa caaaaaccaa caaaataacc ttgaaaacca aaaaaccaa acataaacc 780
agacccagaa aaacatagac accatatgga aggttctagc atatgcacca atgagatggc 840
atctgttcac gtatcaatag caccaccatc attcaaggaa taagaagagg cgaaaattta 900
a 901

```

<210> 106

<211> 901

<212> DNA

<213> human metapneumo virus

<400> 106

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atggaagtaa gaggtagagaa cattcgagcg atagacatgt tcaaagcaaa gataaagaac 60
cgtataagaa gcagcagggtg ctatagaaat gctacactga tccttatttg actaacagcg 120
ttaagcatgg cacttaatat tttcctgata attgatcatg caacattaag aaacatgata 180
aaaacagaaa actgtgctaa catgccatcg gcagaaccaa gcaaaaagac cccaatgacc 240
tccacagcag gcccaagcac cgaaccatc ccacagcaag caacacaaatg gaccacagag 300
aactcaacat cccagcagc aaccctagag agccatccat acacagggac aaccacaaaca 360
ccagacataa cagctcccca acaaacacaca gacaaacaca cagcactgcc aaaatcaacc 420

```

```

aatgaacaga tcacccagac aaccacagag aaaaagacaa ccagagcaac aacccaaaaa 480
agggaaaaaag aaaaagaaaa cacaaaccaa accacaagca cagctgcaac ccaaacaacc 540
aacaccacca accaaaccag aaatgcaagt gagacaatca caacatccga cagaccacaga 600
attgacacca caacccaaag cagcgatcag acaacccggg caacagaccc aagctcccca 660
ccacaccatg cacagagtgg tgcaaaaccc aaatgaacac aacacacaaa catctcatcc 720
aagtagttaa caaaaaacca caaaataacc ttgaaaacca aaaaacccaa ccacaaaactt 780
agaccagaa aaacatagac actatatgga aggtttgagc atatgcacca atgaaatggg 840
atctgttcat gtatcaatag cgccaccatt atttaaggaa taagaagagg caaaaattca 900
a

```

<210> 107

<211> 860

<212> DNA

<213> human metapneumo virus

<400> 107

```

atggaagtaa gagtggagaa cattcgagcg atagacatgt tcaaagcaaa gataaaaaaac 60
cgtataagaa gcagcaggtg ctatagaaat gctacactga tccttattgg actaacagcg 120
ttaagcatgg cacttaatat ttctctgac atcgatcatg caacattaag aaacatgac 180
aaaacagaaa attgtgctaa catgccgccc gcagaaccaa gcaaaaagac cccaatgacc 240
tctacagcag gcccaaacac caaacccaat ccacagcaag caacacagtg gaccacggag 300
aactcaacat tcccagcagc aacctcagag ggccatctac acacagggag aactcaaaca 360
ccagacacaa cagctcctca gcaaaccaca gacaaacaca cagcactgcc aaaatcaacc 420
aatgaacaaa tcacccagac aaccacagag aaaaagacaa ccagagcaac aacccaaaga 480
agggaaaaaag ggaaagaaaa cacaaaccaa accacaagca cagctgctac ccaaacaacc 540
aacaccacca accaaatcag aaatgcaagc gagacaatca caacatccga cagaccacaga 600
actgactcca caacccaaaag cagcgaacag acaacccggg caacagaccc aagctcccca 660
ccacatcatg cacagggaag tgcaaaaccc aaatgaacac aacacacaaa catcccatcc 720
aagtagttaa caaaaaatca gaccagaaa aacatagaca ctatatggaa ggtccgagca 780
tatgcaccga tgaaatggca ttgttcatg tatcaatagc gccaccatta tttaaggaat 840
aagaagaggc aaaaattcaa

```

<210> 108

<211> 861

<212> DNA

<213> human metapneumo virus

<400> 108

```

atggaagtaa gagtggagaa cattcgagcg atagacatgt tcaaagcaaa gataaaaaaac 60
cgtataagaa gcagcaggtg ctatagaaat gctacactga tccttattgg actaacagcg 120
ttaagcatgg cacttaatat ttctctgac atcgatcatg caacattaag aaacatgac 180
aaaacagaaa attgtgctaa catgccgccc gcagaaccaa gcaaaaagac cccaatgacc 240
tccacagcag gcccaaacac caaacccaat ccacagcaag caacacagtg gaccacggag 300
aactcaacat ccccagcagc aaccccagag ggccatctac acacagggag aactcaaaca 360
ccagacacaa cagctcctca gcaaaccaca gacaaacaca cagcactgcc aaaatcaacc 420
aatgaacaga tcacccaggc aaccacagag aaaaagacaa ccagagaaac aacccaaaga 480
agggaaaaaag gaaaagaaaa cacaaaccaa accacaagca cagctgcaac ccaaacaacc 540
aacaccacca accaaatcag aaatgcaagc gagacaatca caacatccga cagaccacaga 600
actgactcca caacccaaaag cagcgaacag acaacccagg caacagaccc aagctcccca 660
gcacaccatg cacagggaag tgcaaaaccc aaatgaacac aacacacaaa catcccatcc 720
aagtagttaa caaaaaaatc agaccagaa aaacacagac actatatgga aggtccgagc 780
atatgcaccg atgaaatggc atctgttcat gtatcaatag caccaccatt atttaaggaa 840
taagaagagg caaaaattca a

```

<210> 109

<211> 860

<212> DNA

<213> human metapneumo virus

<400> 109

```

atggaagtaa gagtggagaa cattcgagcg atagacatgt tcaaagcaaa gataaaaaaac 60

```



```

cgtataagaa gcagcaggtg ctatagaaat gctacattga tccttattgg actaacagcg 120
ttaagcatgg cacttaatat tttcctgata atcgatcatg caacattaag aaacatgata 180
aaaacagaaa attgtgctaa catgccaccg gcagaaccaa gcaaaaagac cccaatgacc 240
tccacagcag gcctaaacac taaacccaat ccacagcaag caacacagtg gaccacggag 300
aactcaacat cccagcagc aacccagag ggccatctac acacagggac aactcaaaca 360
ccagacacaa cagctcctca gcaaaccaca gacaagcaca cagcactgcc aaaatcaacc 420
aatgaacaga tcaccagag aaccacagag aaaaagacaa ccagagcaac aacccaaaga 480
agggaaaaag gaaaagaaaa cacaaccaa accacaagca cagctgcaac ccaaacaacc 540
aacaccacca accaaatcag aaatgcaagc gagacaatca caacatccga cagaccaga 600
actgactcca caacccaaag cagcgaacag acaacccggg caacagaccc aagctcccca 660
ccacaccatg cacagggag tgcaaaaccc aaatgaacac aacacacaaa catcccatcc 720
aagtagttaa caaaaaatca gaccagaaa aacatagaca ctatatggaa ggtccgagca 780
tatgcaccga tgaaatggca tctgttcatg tatcaatagc gccaccatta ttttaaggaat 840
aagaagaggc aaaaattcaa                                     860

```

<210> 110

<211> 860

<212> DNA

<213> human metapneumo virus

<400> 110

```

atggaagtaa gagtggagaa cattcgagcg atagacatgt tcaaagcaaa gataaaaaac 60
cgtataagaa gcagcaggtg ctatagaaat gctacactga tccttattgg actaacagcg 120
ttaagcatgg cacttaatat tttcctgata atcgatcatg caacattaag aaacatgata 180
aaaacagaaa attgtgctaa catgccgccg gcagaaccaa gcaaaaagac cccaatgacc 240
tccacagcag gcccaaacac caaacccaat ccacagcaag caacacagtg gaccacggag 300
aactcaacat cccagcagc aacccagag ggccatctac acacagggac aactcaaaca 360
ccagacacaa cagctcctca gcaaaccaca gacaacacaa ccagagcaac aacccaaaga 480
aatgaacaga tcaccagag aaccacagag aaaaagacaa ccagagcaac aacccaaaga 480
agggaaaaag gaaaagaaaa cacaaccaa accacaagca cagctgcaac ccaaacaacc 540
aacaccacca accaaatcag aaatgcaatt gagacaatca caacatccga cagaccaga 600
actgactcca caacccaaag cagcgaacag acaacccggg caacagaccc aagctccac 660
ccacaccatg cacagggag tgcaaaaccc aaatgaacac aacacacaaa catcccatcc 720
aagtagttaa caaaaaatca gaccagaaa aacatagaca ctatatggaa ggtccgagca 780
tatgcaccga tgaaatggca tctgttcatg tatcaatagc gccaccatta ttttaaggaat 840
aagaagaggc aagaattcaa                                     860

```

<210> 111

<211> 886

<212> DNA

<213> human metapneumo virus

<400> 111

```

atggaagtaa gagtggagaa cattcgggca atagacatgt tcaaagcaaa aatgaaaaac 60
cgtataagaa gtagcaagtgc ctatagaaat gctacactga tccttattgg attaacagca 120
ttaagtagtg cacttaatat ttttttaatc attgattatg caatgttaaa aaacatgacc 180
aaagtgggag actgtgttaa tatgccgccg gtagaaccaa gcaagaagac cccaatgacc 240
tctgcagtag acttaaacac caaacccaat ccacagcagg caacacagtt ggccgcagag 300
gattcaacat ctctagcagc aacctcagag gaccatctac acacagggac aactccaaca 360
ccagatgcaa cagtctctca gcaaaccaca gacgagtaca caacattgct gagatcaacc 420
aacagacaga ccacccaaac aaccacagag aaaaagccaa ccggagcaac aaccaaaaaa 480
gaaaccacaa ctcgaaactac aagcacagct gcaacccaaa cactcaacac taccaaccaa 540
actagctatg tgagagaggc aaccacaaca tccgccagat ccagaaacag tgccacaact 600
caaagcagcg accaaacaac ccaggcagca gacccaagct cccaaccaca ccatacacag 660
aaaagcacia caacaacata caacacagac acatcctctc caagtagtta acaaaaaaac 720
tataaataaa tcataaaaac cgaaaaacta gaaaagttaa tttgaactca gaaaagaaca 780
caaacactat atgaattgtt tgagcgtata tactaatgaa atagcatctg tttgtgcatc 840
aataatacca tcattattta agaaataaga agaagctaaa attcaa                                     886

```

<210> 112

<211> 889

<212> DNA

<213> human metapneumo virus

<400> 112

```

atggaagtaa gagtggagaa cattcggaca atagacatgt tcaaagcaaa gatgaaaaac 60
cgtataagaa gcagcaagtg ctatagaaat gctacactga tccttatttg actgacagca 120
ttaagtatgg cacttaatat tttcttgatc atcgattatg caacatttaa aaacatgacc 180
aaagtggaa actgtgctaa tatgccgccg gtagaaccga gtaagaagac cccaatgacc 240
tctacagtag actcaagcac cggacccaat ccacagcaga caacacagtg gaccacagag 300
gattcaacat ctctagcagc aacctcagag gaccatctac acacagggac aactccaaca 360
ctagatgcaa cagtttctca gcaaacccca gacaagcaca caacaccgct gagatcaacc 420
aatggacaga ccaccagac aaccacagag aaaaagccaa ccagagcaat agccaaaaaa 480
gaaaccacaa accaaaccac aagcacagct gcaacccaaa cattcaacac caccaatcaa 540
accagaaatg gaagagagac aaccataaca tctgccagat ccagaaaacga cgccacaact 600
caaagcagcg aacaaacaaa ccagacaaca gacccaagct cccaaccaca tcatgcatag 660
ataagcacaa taacaatatg aacacaacac agacacatct tctccaagta gtttaacaaa 720
aactataaaa taaccatgaa aaccaaaaaa ctagaaaagt aaatttgaac tcagaaaaga 780
acacaacac taaatgaatt gtttgagcat atatactaata gaaatagcat ctgttcatgc 840
atcaataata ccattcattac ttaagaaata agaagaagca aaaattcaa 889

```

<210> 113

<211> 885

<212> DNA

<213> human metapneumo virus

<400> 113

```

atggaagtaa gagtggagaa cattcgggca atagacatgt tcaaagcaaa gatgaaaaac 60
cgtataagaa gtagcaagtg ctatagaaat gctacactga tccttatttg attaacagca 120
ttaagtatgg cacttaatat ttttttaatc attgattatg caatgttaaa aaacatgacc 180
aaagtggaa actgtgttaa tatgccgccg gtagaaccga gcaagaagac cccaatgacc 240
tctgcagtag acttaaacac caaactcaat ccacagcagg caacacagtt gaccacagag 300
gattcaacat ctctagcagc aacctcggag gatcattttac tcacagggac aactccaaca 360
ccagatgcaa cagtctctca gcaaacccca gacgagcaca caacactgct gagatcaacc 420
aacagacaga ccacccaaac aaccacagag aaaaagccaa ccggagcaac aaccaaaaaa 480
gaaaccacaa ctgcaaccac aagcacagct gcaacccaaa cactcaacac caccaaccaa 540
actagcaatg aaagagaggc aaccacaaca tccaccagat ccagaaaacg tgccacaact 600
caaaacagcg atcaaacac ctagacagca gacccaagct cccaaccaca ccatacacag 660
aaaagcacia caacaacata caacacagac acatcttctc caagtagtta acaaaaaact 720
ataaaaataac catgaaaact aaaaaactag aaaagttaat ttgaactcag aaaagaacac 780
aaacactata tgaattgttt gagcgtatat actaatgaaa tagcatctgt ttgtgcatca 840
ataataccat cattatttaa gaaataagaa gaagctaaaa ttcaa 885

```

<210> 114

<211> 885

<212> DNA

<213> human metapneumo virus

<400> 114

```

atggaagtaa gagtggagaa cattcgggca atagacatgt tcaaagcaaa gatgaaaaac 60
cgcataagaa gtagcaagtg ctatagaaat gctacactga tccttatttg attaacagca 120
ttaagtatgg cacttaatat ttttttaatc attgattatg caacatttaa aaacatgacc 180
aaagtggaa actgtgttaa tatgccgccg gtagaaccga gcaagaagac cccaatgacc 240
tctgcagtag acttaaacac caaactcaat ccacagcagg caacacagtt gaccacagag 300
gattcaacat ctctagcagc aacctcagag ggccatccac acacaggaac aactccaaca 360
ccagacgcaa cagtctctca gcaaacccca gacgagcaca caacactgct gagatcaacc 420
aacagacaga ccacccaaac agccacagag aaaaagccaa ctggagcaac aaccaaaaaa 480
gaaaccacaa cccgaactac aagtacagct gcaacccaaa caccacacac caccaaccaa 540
accagcaatg gaagagaggc aaccacaaca tccgccaggt ccagaaaacg tgccacaact 600
caaaacagcg atcaaaaata ccaggcagca gactcaagct cccaaccaca ccatacacag 660
aaaagcacia caacagcata caacacagac acatcttttc caagtagtta acaaaaaact 720
ataaaaataac catgaaaacc aaaaaactag aaaagttaat ttgaactcag aaaagaacac 780

```

aaacactata tgaattgttt gagcgtatat actaatgaaa tagcatctgt ttgtgcatca 840
 ataataccat cattatttta gaaataagaa gaagctaaaa ttcaa 885

<210> 115

<211> 886

<212> DNA

<213> human metapneumo virus

<400> 115

atggaagtaa gaggaggagaa cattcgggca atagacatgt tcaaagcaaa gatgaaaaac 60
 cgtataagaa gtagcaagtg ctatagaaat gctacactga tccttattgg attaacagca 120
 ctaagtattg cacttaatat ttttttaatc attgattatg caacattaaa aaacatgacc 180
 aaagtggaa actgtgttaa tatgccgccg gtagaaccac gcaagaagac cccaatgacc 240
 tctgcagtag actcaaacac caaacccaat ccacagcagg caacacagtt gaccacagag 300
 gattctacat ctttagcagc aaccctagag gaccatccac acacagggac aactccaaca 360
 ccagatgcaa cagtctctca gcaaaccaca gacgagcaca caacactgct gagatcaacc 420
 aacagacaga ccacccaaac aactgcagag aaaaagccaa ccagggcaac aaccaaaaaa 480
 gaaaccacaa ctggaaccac aagcacagct gcaacccaaa cactcaacac caccaaccaa 540
 actagcaatg gaagagaggc aaccacaaca tctgccagat ccagaaacaa tgccacaact 600
 caaagcagcg atcaaacac ccaggcagca gaaccaagct cccaatcaca acatacacag 660
 aaaagcacaa caacaacata caacacagac acatcttctc taagtagtta acaaaaaaac 720
 tataaaataa ccatgaaaac caaaaaacta gaaaagttaa tttgaactca gaaaagaaca 780
 caaacactat atgaattatt tgagcgtata tactaatgaa atagcatctg tttgtgcatc 840
 aataatacca tcattattta agaaataaga agaagctaaa attcaa 886

<210> 116

<211> 887

<212> DNA

<213> human metapneumo virus

<400> 116

atggaagtaa gaggaggagaa cattcgggca atagacatgt tcaaagcaaa gatgaaaaac 60
 cgtataagaa gtagcaagtg ctatagaaat gctacactga tccttattgg attatcagca 120
 ctaagtattg cacttaatat ttttttaatc attgattatg caaaatcaaa aaacatgacc 180
 agagtggaa actgtgtcaa tatgccgccg gtagaaccac gcaagaagac cccaatgacc 240
 tctgcagtag acttaaacac caaacccaat ccacagcagg caacacagtt gaccacagag 300
 gattcaacat ctctagcagc aaccctagag ggccatctac acacagggac aactccaaca 360
 ccagatgtaa cagtctctca gcaaaccaca gacgagcaca caacactgct gagatcaacc 420
 aacagacaga ccacccaaac agccgcagag aaaaagccaa ccagagtaac aactaacaaa 480
 gaaaccataa ctggaaccac aagcacagcc gcaacccaaa cactcaacac caccaaccaa 540
 accaacaatg gaagagaggc aaccacaaca tctgccagat ccagaaacaa tgccacaact 600
 caaagcagcg accaaacaac ccaggcagca gacccaagct cccaatcaca acatacacag 660
 aaaagcataa caacaacata caacacagac acatcttctc caagtagtta acaaaaaaac 720
 tataaaataa ccatgaaaac caaaaaacta agaaaagtta atttgaactc agaaaagaac 780
 acaaacacta tatgaattgt ttgagcgtat atactaatga aatagcatct gtttgtgcat 840
 caataatacc atcattattt aagaattaag aagaagctaa aattcaa 887

<210> 117

<211> 887

<212> DNA

<213> human metapneumo virus

<400> 117

atggaagtaa gaggaggagaa cattcgggca atagacatgt tcaaagcaaa gatgaaaaac 60
 cgtataagaa gtagcaagtg ctatagaaat gctacactga tccttattgg attatcagca 120
 ctaagtattg cacttaatat ttttttaatc attgattatg caaaatcaaa aaccatgacc 180
 agagtggaa actgtgttaa tatgccgccg gtagaaccac gcaagaagac cccaatgacc 240
 tctgcagtag acttaaacac caaacccaat ccacagcagg caacacagtt gaccacagag 300
 gattcaacat ctccagcagc aaccctagag ggccatctac acacagggac aactccaaca 360
 ccagatgcaa cagtctctca gcaaaccaca gacgagcaca caacactgct gagatcaacc 420
 aacagacaga ccacccaaac aaccgcagag aaaaagccaa ccagagcaac aaccaaaaaa 480

```

gaaaccataa ctcgaaccac aagcacagct gcaacccaaa cactcaacac caccaaccaa 540
accagcaatg gaagagagggc aaccacaaca tctgccagat ccagaaacaa tgccacaact 600
caaagcagcg accaaacaac ccaggcagca gacccaagct cccaatcaca acatacaaaag 660
aaaagcacaa caacaacata caacacagac acatcttctc caagtagtta acaaaaaaac 720
tataaaataa ccatgaaaac caaaaaaact agaaaagtta atttgaactc agaaaagaac 780
acaaacacta tatgaattgt ttgagcgtat atactaatga aatagcatct gtttgtgcat 840
caataatacc atcattatatt aagaattaag aagaagctaa aattcaa 887

```

<210> 118

<211> 886

<212> DNA

<213> human metapneumo virus

<400> 118

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atggaagtaa gaggaggagaa cattcgggca atagacatgt tcaaagcaaa gatgaaaaaac 60
cgtataagaa gtagcaagtg ctatagaaat gctacactga tccttatttgg attaacagca 120
ctaagtatgg cacttaatat ttttttaatc attgattatg caacattaaa aaacatgacc 180
aaagtggaaac actgtgttaa tatgccgccg gtagaaccaa gcaagaagac cccaatgacc 240
tctgcagtag acttaaacac caaacccaat ccacagcagg caacacagtt gaccacagag 300
gactctacat ctttagcagc aaccttagag gaccatccac acacagggac aactccaaca 360
ccagatgcaa cagtctctca gcaaacacac gacgagcaca caacactgct gagatcaacc 420
aacagacaga ccacccaaac aactgcagag aaaaagccaa ccagagcaac aacaaaaaaa 480
gaaaccacaa ctcgaaccac aagcacagct gcaacccaaa cactcaacac caccaaccaa 540
actagcaatg gaagagagggc aaccacaaca tctgccagat ccagaaacaa tgccacaact 600
caaagcagcg atcaaacac ccaagcagca gaaccaaact cccaatcaca acatacacag 660
aaaagcacaa caacaacata caacacagac acatcttctc taagtagtta acaaaaaaac 720
tataaaataa ccatgaaaac caaaaaacta gaaaagttaa tttgaactca gaaaggaaca 780
caaacactat atgaattatt tgagcgtata tactaatgaa atagcatctg tttgtgcatc 840
aataatacca tcattattta agaaataaga agaagctaaa attcaa 886

```

<210> 119

<211> 236

<212> PRT

<213> human metapneumo virus

<400> 119

```

Met Glu Val Lys Val Glu Asn Ile Arg Thr Ile Asp Met Leu Lys Ala
1          5          10          15
Arg Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
20          25          30
Leu Val Leu Ile Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
35          40          45
Leu Ile Ile Asn Tyr Lys Met Gln Lys Asn Thr Ser Glu Ser Glu His
50          55          60
His Thr Ser Ser Ser Pro Met Glu Ser Ser Arg Glu Thr Pro Thr Val
65          70          75          80
Pro Thr Asp Asn Ser Asp Thr Asn Ser Ser Pro Gln His Pro Thr Gln
85          90          95
Gln Ser Thr Glu Gly Ser Thr Leu Tyr Phe Ala Ala Ser Ala Ser Ser
100          105          110
Pro Glu Thr Glu Pro Thr Ser Thr Pro Asp Thr Thr Asn Arg Pro Pro
115          120          125
Phe Val Asp Thr His Thr Thr Pro Pro Ser Ala Ser Arg Thr Lys Thr
130          135          140
Ser Pro Ala Val His Thr Lys Asn Asn Pro Arg Thr Ser Ser Arg Thr
145          150          155          160
His Ser Pro Pro Arg Ala Thr Thr Arg Thr Ala Arg Arg Thr Thr Thr
165          170          175
Leu Arg Thr Ser Ser Thr Arg Lys Arg Pro Ser Thr Ala Ser Val Gln
180          185          190
Pro Asp Ile Ser Ala Thr Thr His Lys Asn Glu Glu Ala Ser Pro Ala

```

	195		200		205
Ser	Pro	Gln	Thr	Ser	Ala
	210		215		220
Glu	Ala	Asn	Thr	Ser	Thr
225			230		235

<210> 120
 <211> 236
 <212> PRT
 <213> human metapneumo virus

<400> 120
 Met Glu Val Lys Val Glu Asn Ile Arg Thr Ile Asp Met Leu Lys Ala
 1 5 10 15
 Ser Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
 20 25 30
 Leu Val Leu Ile Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
 35 40 45
 Leu Ile Ile Asn Tyr Lys Met Gln Lys Asn Thr Ser Glu Ser Glu His
 50 55 60
 His Thr Ser Ser Ser Pro Met Glu Ser Ser Arg Glu Thr Pro Thr Val
 65 70 75 80
 Pro Thr Asp Asn Ser Asp Thr Asn Ser Ser Pro Gln His Pro Thr Gln
 85 90 95
 Gln Ser Thr Glu Gly Ser Thr Leu Tyr Phe Ala Ala Ser Ala Ser Ser
 100 105 110
 Pro Glu Thr Glu Pro Thr Ser Thr Pro Asp Thr Thr Asn Arg Pro Pro
 115 120 125
 Phe Val Asp Thr His Thr Thr Pro Pro Ser Ala Ser Arg Thr Lys Thr
 130 135 140
 Ser Pro Ala Val His Thr Lys Asn Asn Pro Arg Thr Ser Ser Arg Thr
 145 150 155 160
 His Ser Pro Pro Arg Ala Thr Thr Arg Thr Ala Arg Arg Thr Thr Thr
 165 170 175
 Leu Arg Thr Ser Ser Thr Arg Lys Arg Pro Ser Thr Ala Ser Val Gln
 180 185 190
 Pro Asp Ile Ser Ala Thr Thr His Lys Asn Glu Glu Ala Ser Pro Ala
 195 200 205
 Ser Pro Gln Thr Ser Ala Ser Thr Thr Arg Ile Gln Arg Lys Ser Val
 210 215 220
 Glu Ala Asn Thr Ser Thr Thr Tyr Asn Gln Thr Ser
 225 230 235

<210> 121
 <211> 236
 <212> PRT
 <213> human metapneumo virus

<400> 121
 Met Glu Val Lys Val Glu Asn Ile Arg Thr Ile Asp Met Leu Lys Ala
 1 5 10 15
 Arg Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
 20 25 30
 Leu Val Leu Ile Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
 35 40 45
 Leu Ile Ile Asn Tyr Lys Met Gln Lys Asn Thr Ser Glu Ser Glu His
 50 55 60
 His Thr Ser Ser Ser Pro Met Glu Ser Ser Arg Glu Thr Pro Thr Val
 65 70 75 80

Pro Thr Asp Asn Ser Asp Thr Asn Ser Ser Pro Gln His Pro Thr Gln
 85 90 95
 Gln Ser Thr Glu Gly Ser Thr Leu Tyr Phe Ala Ala Ser Ala Asn Ser
 100 105 110
 Pro Glu Thr Glu Pro Thr Ser Thr Pro Asp Thr Thr Asn Arg Pro Pro
 115 120 125
 Phe Val Asp Thr His Thr Thr Pro Pro Ser Ala Ser Arg Thr Lys Thr
 130 135 140
 Ser Pro Ala Val His Thr Lys Asn Asn Pro Arg Ile Ser Ser Arg Thr
 145 150 155 160
 His Ser Pro Pro Trp Ala Thr Thr Arg Thr Ala Arg Arg Thr Thr Thr
 165 170 175
 Leu Arg Thr Ser Ser Thr Arg Lys Arg Pro Ser Thr Ala Ser Ala Gln
 180 185 190
 Pro Asp Ile Ser Ala Thr Thr His Lys Asn Glu Glu Ala Ser Pro Ala
 195 200 205
 Ser Pro Gln Thr Ser Ala Ser Thr Thr Arg Thr Gln Arg Lys Ser Val
 210 215 220
 Glu Ala Asn Thr Ser Thr Thr Tyr Asn Gln Thr Ser
 225 230 235

<210> 122

<211> 236

<212> PRT

<213> human metapneumo virus

<400> 122

Met Glu Val Lys Val Glu Asn Ile Arg Thr Ile Asp Met Leu Lys Ala
 1 5 10 15
 Arg Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
 20 25 30
 Leu Val Leu Ile Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
 35 40 45
 Leu Ile Ile Asn Tyr Lys Met Gln Lys Asn Thr Ser Glu Ser Glu His
 50 55 60
 His Thr Ser Ser Ser Pro Met Glu Ser Ser Arg Glu Thr Pro Thr Val
 65 70 75 80
 Pro Thr Asp Asn Ser Asp Thr Asn Ser Ser Pro Gln His Pro Thr Gln
 85 90 95
 Gln Ser Thr Glu Gly Ser Thr Leu Tyr Phe Ala Ala Ser Ala Asn Ser
 100 105 110
 Pro Glu Thr Glu Pro Thr Ser Thr Pro Asp Thr Thr Asp Arg Pro Pro
 115 120 125
 Phe Val Asp Thr His Thr Thr Pro Pro Ser Ala Ser Arg Thr Lys Thr
 130 135 140
 Ser Pro Ala Val His Thr Lys Asn Asn Pro Arg Ile Ser Ser Arg Thr
 145 150 155 160
 His Ser Pro Pro Trp Ala Thr Thr Arg Thr Ala Arg Arg Thr Thr Thr
 165 170 175
 Leu Arg Thr Ser Ser Thr Arg Lys Arg Pro Ser Thr Ala Ser Val Gln
 180 185 190
 Pro Asp Ile Ser Ala Thr Thr His Lys Asn Glu Glu Ala Ser Pro Ala
 195 200 205
 Ser Pro Gln Thr Ser Ala Ser Thr Thr Arg Thr Gln Arg Lys Ser Val
 210 215 220
 Glu Ala Asn Thr Ser Thr Thr Tyr Asn Gln Thr Ser
 225 230 235

<210> 123

<211> 236
 <212> PRT
 <213> human metapneumo virus

<400> 123
 Met Glu Val Lys Val Glu Asn Ile Arg Thr Ile Asp Met Leu Lys Ala
 1 5 10 15
 Arg Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
 20 25 30
 Leu Val Leu Ile Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
 35 40 45
 Leu Ile Ile Asn Tyr Lys Met Gln Lys Asn Thr Ser Glu Ser Glu His
 50 55 60
 His Thr Ser Ser Ser Pro Met Glu Ser Ser Arg Glu Thr Pro Thr Val
 65 70 75 80
 Pro Thr Asp Asn Ser Asp Thr Asn Ser Ser Pro Gln His Pro Thr Gln
 85 90 95
 Gln Ser Thr Glu Gly Ser Thr Leu Tyr Phe Ala Ala Ser Ala Ser Ser
 100 105 110
 Pro Glu Thr Glu Pro Thr Ser Thr Pro Asp Thr Thr Asp Arg Pro Pro
 115 120 125
 Phe Val Asp Thr His Thr Thr Pro Pro Ser Ala Ser Arg Thr Lys Thr
 130 135 140
 Ser Pro Ala Val His Thr Lys Asn Asn Pro Arg Ile Ser Ser Arg Thr
 145 150 155 160
 His Ser Pro Pro Trp Ala Thr Thr Arg Thr Ala Arg Arg Thr Thr Thr
 165 170 175
 Leu Arg Thr Ser Ser Thr Arg Lys Arg Pro Ser Thr Ala Ser Val Gln
 180 185 190
 Pro Asp Ile Ser Ala Thr Thr His Lys Asn Glu Glu Ala Ser Pro Ala
 195 200 205
 Ser Pro Gln Thr Ser Ala Ser Thr Thr Arg Thr Gln Arg Lys Ser Val
 210 215 220
 Glu Ala Asn Thr Ser Thr Thr Tyr Asn Gln Thr Ser
 225 230 235

<210> 124
 <211> 236
 <212> PRT
 <213> human metapneumo virus

<400> 124
 Met Glu Val Lys Val Glu Asn Ile Arg Thr Ile Asp Met Leu Lys Ala
 1 5 10 15
 Arg Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
 20 25 30
 Leu Ile Leu Ile Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
 35 40 45
 Leu Ile Ile Asn Tyr Thr Met Gln Glu Asn Thr Ser Glu Ser Glu His
 50 55 60
 His Thr Ser Ser Ser Pro Met Glu Ser Ser Arg Glu Thr Pro Thr Val
 65 70 75 80
 Pro Ile Asp Asn Ser Asp Thr Asn Pro Gly Ser Gln Tyr Pro Thr Gln
 85 90 95
 Gln Ser Thr Glu Asp Ser Thr Leu His Ser Ala Ala Ser Ala Ser Ser
 100 105 110
 Pro Glu Thr Glu Pro Thr Ser Thr Pro Asp Thr Thr Ser Arg Pro Pro
 115 120 125
 Phe Val Asp Thr His Thr Thr Pro Pro Ser Ala Ser Arg Thr Arg Thr
 130 135 140

Ser Pro Ala Val His Thr Lys Asn Asn Pro Arg Val Ser Pro Arg Thr
 145 150 155 160
 His Ser Pro Pro Trp Ala Met Thr Arg Thr Val Arg Gly Thr Thr Thr
 165 170 175
 Leu Arg Thr Ser Ser Thr Arg Lys Arg Leu Ser Thr Ala Ser Val Gln
 180 185 190
 Pro Asp Ser Ser Ala Thr Thr His Lys His Glu Glu Thr Ser Pro Val
 195 200 205
 Ser Pro Gln Thr Ser Ala Ser Thr Ala Arg Pro Gln Arg Lys Gly Met
 210 215 220
 Glu Ala Ser Thr Ser Thr Thr Tyr Asn Gln Thr Ser
 225 230 235

<210> 125

<211> 236

<212> PRT

<213> human metapneumo virus

<400> 125

Met Glu Val Lys Val Glu Asn Ile Arg Thr Ile Asp Met Leu Lys Ala
 1 5 10 15
 Arg Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
 20 25 30
 Leu Ile Leu Ile Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
 35 40 45
 Leu Ile Ile Asn Tyr Thr Met Gln Glu Asn Thr Ser Glu Ser Glu His
 50 55 60
 His Thr Ser Ser Ser Pro Met Glu Ser Ser Arg Glu Thr Pro Thr Val
 65 70 75 80
 Pro Met Asp Asn Ser Asp Thr Asn Pro Gly Ser Gln Tyr Pro Thr Gln
 85 90 95
 Gln Ser Thr Glu Gly Ser Thr Leu His Phe Ala Ala Ser Ala Ser Ser
 100 105 110
 Pro Glu Thr Glu Pro Thr Ser Thr Pro Asp Thr Thr Ser Arg Pro Pro
 115 120 125
 Phe Val Asp Thr His Thr Thr Pro Ser Ser Ala Ser Arg Thr Lys Thr
 130 135 140
 Ser Pro Ala Val His Thr Lys Asn Asn Leu Arg Ile Ser Pro Arg Thr
 145 150 155 160
 His Ser Pro Pro Trp Ala Met Thr Arg Thr Val Arg Gly Thr Thr Thr
 165 170 175
 Leu Arg Thr Ser Ser Ile Arg Lys Arg Pro Ser Thr Ala Ser Val Gln
 180 185 190
 Pro Asp Ser Ser Ala Thr Thr His Lys His Glu Glu Ala Ser Pro Val
 195 200 205
 Ser Pro Gln Ala Ser Ala Ser Thr Ala Arg Pro Gln Arg Lys Gly Met
 210 215 220
 Glu Ala Ser Thr Ser Thr Thr Tyr Asn Gln Thr Ser
 225 230 235

<210> 126

<211> 236

<212> PRT

<213> human metapneumo virus

<400> 126

Met Glu Val Lys Val Glu Asn Ile Arg Thr Ile Asp Met Leu Lys Ala
 1 5 10 15
 Arg Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser

<400>	127															
Met	Glu	Val	Lys	Val	Glu	Asn	Ile	Arg	Ala	Ile	Asp	Met	Leu	Lys	Ala	
1				5					10					15		
Arg	Val	Lys	Asn	Arg	Val	Ala	Arg	Ser	Lys	Cys	Phe	Lys	Asn	Ala	Ser	
			20					25					30			
Leu	Ile	Leu	Ile	Gly	Ile	Thr	Thr	Leu	Ser	Ile	Ala	Leu	Asn	Ile	Tyr	
		35					40					45				
Leu	Ile	Ile	Asn	Tyr	Thr	Ile	Gln	Lys	Thr	Thr	Ser	Glu	Ser	Glu	His	
	50					55					60					
His	Thr	Ser	Ser	Pro	Pro	Thr	Glu	Pro	Asn	Lys	Glu	Ala	Ser	Thr	Ile	
65				70						75					80	
Ser	Thr	Asp	Asn	Pro	Asp	Ile	Asn	Pro	Ser	Ser	Gln	His	Pro	Thr	Gln	
			85						90					95		
Gln	Ser	Thr	Glu	Asn	Pro	Thr	Leu	Asn	Pro	Ala	Ala	Ser	Ala	Ser	Pro	
			100					105					110			
Ser	Glu	Thr	Glu	Pro	Ala	Ser	Thr	Pro	Asp	Thr	Thr	Asn	Arg	Leu	Ser	
		115					120					125				
Ser	Val	Asp	Arg	Ser	Thr	Ala	Gln	Pro	Ser	Glu	Ser	Arg	Thr	Lys	Thr	
	130					135					140					
Lys	Pro	Thr	Val	His	Thr	Ile	Asn	Asn	Pro	Asn	Thr	Ala	Ser	Ser	Thr	
145				150						155					160	
Gln	Ser	Pro	Pro	Arg	Thr	Thr	Thr	Lys	Ala	Ile	Arg	Arg	Ala	Thr	Thr	

165 170 175
 Phe Arg Met Ser Thr Gly Lys Arg Pro Thr Thr Thr Leu Val Gln
 180 185 190
 Ser Asp Ser Ser Thr Thr Thr Gln Asn His Glu Glu Thr Gly Ser Ala
 195 200 205
 Asn Pro Gln Ala Ser Ala Ser Thr Met Gln Asn Xaa His Thr Asn Asn
 210 215 220
 Ile Lys Pro Asn
 225

<210> 128
 <211> 228
 <212> PRT
 <213> human metapneumo virus

<400> 128
 Met Glu Val Lys Val Glu Asn Ile Arg Ala Ile Asp Met Leu Lys Ala
 1 5 10 15
 Arg Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
 20 25 30
 Leu Ile Leu Ile Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
 35 40 45
 Leu Ile Ile Asn Tyr Thr Ile Gln Lys Thr Thr Ser Glu Ser Glu His
 50 55 60
 His Thr Ser Ser Pro Pro Thr Glu Ser Asn Lys Glu Thr Ser Thr Ile
 65 70 75 80
 Pro Ile Asp Asn Pro Asp Ile Asn Pro Asn Ser Gln His Pro Thr Gln
 85 90 95
 Gln Ser Thr Glu Ser Pro Thr Leu Asn Pro Ala Ala Ser Val Ser Pro
 100 105 110
 Ser Glu Thr Glu Pro Ala Ser Thr Pro Asp Thr Thr Asn Arg Leu Ser
 115 120 125
 Ser Val Asp Arg Ser Thr Thr Gln Pro Ser Glu Ser Arg Thr Lys Thr
 130 135 140
 Lys Pro Thr Val His Thr Lys Asn Asn Pro Ser Thr Val Ser Arg Thr
 145 150 155 160
 Gln Ser Pro Leu Arg Ala Thr Thr Lys Ala Val Leu Arg Ala Thr Ala
 165 170 175
 Phe Arg Thr Ser Ser Thr Arg Lys Arg Pro Thr Thr Thr Ser Val Gln
 180 185 190
 Ser Asp Ser Ser Thr Thr Thr Gln Asn His Glu Glu Thr Ser Ser Ala
 195 200 205
 Asn Pro Gln Ala Ser Ala Ser Thr Met Gln Ser Gln His Thr Asn Asn
 210 215 220
 Ile Lys Pro Asn
 225

<210> 129
 <211> 228
 <212> PRT
 <213> human metapneumo virus

<400> 129
 Met Glu Val Lys Val Glu Asn Ile Arg Ala Val Asp Met Leu Lys Ala
 1 5 10 15
 Arg Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
 20 25 30
 Leu Ile Leu Val Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
 35 40 45

```

Leu Ile Val Asn Tyr Thr Ile Gln Lys Thr Thr Ser Glu Ser Glu His
 50          55          60
His Thr Ser Ser Ser Pro Thr Glu Ser Asn Lys Gly Thr Ser Thr Ile
65          70          75          80
Pro Thr Asp Asn Pro Asp Ile Asn Pro Asn Ser Gln His Pro Thr Gln
          85          90          95
Gln Ser Thr Glu Ser Pro Thr Leu Asn Thr Ala Ala Ser Val Ser Pro
          100          105          110
Ser Glu Thr Glu Pro Ala Ser Thr Pro Asp Thr Thr Asn Arg Leu Ser
          115          120          125
Ser Ala Asp Arg Ser Thr Thr Gln Pro Ser Glu Ser Arg Thr Lys Thr
          130          135          140
Lys Leu Thr Val His Thr Lys Asn Asn Leu Ser Thr Ala Ser Arg Thr
145          150          155          160
Gln Ser Pro Pro Arg Ala Thr Thr Lys Ala Val Leu Arg Asp Thr Ala
          165          170          175
Phe His Thr Ser Ser Thr Gly Lys Arg Pro Thr Thr Thr Ser Val Gln
          180          185          190
Ser Gly Ser Ser Thr Thr Thr Gln Asn His Glu Glu Thr Ser Ser Ser
          195          200          205
Asn Pro Gln Ala Ser Ala Ser Thr Met Gln Asp Gln Asp Thr Asn Asn
          210          215          220
Thr Lys Gln Asn
225

```

<210> 130

<211> 228

<212> PRT

<213> human metapneumo virus

<220>

<221> VARIANT

<222> 81

<223> Xaa = Any Amino Acid

<400> 130

```

Met Glu Val Lys Val Glu Asn Ile Arg Ala Val Asp Met Leu Lys Ala
 1          5          10          15
Arg Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
          20          25          30
Leu Ile Leu Val Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
          35          40          45
Leu Ile Val Asn Tyr Thr Ile Gln Lys Thr Thr Ser Glu Ser Glu His
          50          55          60
His Thr Ser Ser Ser Pro Thr Glu Ser Asn Lys Gly Thr Ser Thr Ile
65          70          75          80
Xaa Thr Asp Asn Pro Asp Ile Asn Pro Asn Ser Gln His Pro Thr Gln
          85          90          95
Gln Ser Thr Glu Ser Pro Thr Leu Asn Thr Ala Ala Ser Val Ser Pro
          100          105          110
Ser Glu Thr Glu Pro Ala Ser Thr Pro Asp Thr Thr Asn Arg Leu Ser
          115          120          125
Ser Ala Asp Arg Ser Thr Thr Gln Pro Ser Glu Ser Arg Thr Lys Thr
          130          135          140
Lys Leu Thr Val His Thr Lys Asn Asn Leu Ser Thr Ala Ser Arg Thr
145          150          155          160
Gln Ser Pro Pro Arg Ala Thr Thr Lys Ala Val Leu Arg Asp Thr Ala
          165          170          175
Phe His Thr Ser Ser Thr Gly Lys Arg Pro Thr Thr Thr Ser Val Gln
          180          185          190

```

Ser Gly Ser Ser Thr Thr Thr Gln Asn His Glu Glu Thr Ser Ser Ser
 195 200 205
 Asn Pro Gln Ala Ser Ala Ser Thr Met Gln Asp Gln Asp Thr Asn Asn
 210 215 220
 Thr Lys Gln Asn
 225

<210> 131
 <211> 228
 <212> PRT
 <213> Human metapneumo virus

<220>
 <221> VARIANT
 <222> 220
 <223> Xaa = unknown amino acid or other

<400> 131
 Met Glu Val Lys Val Glu Asn Ile Arg Ala Ile Asp Met Leu Lys Ala
 1 5 10 15
 Arg Met Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
 20 25 30
 Leu Ile Leu Ile Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
 35 40 45
 Leu Ile Ile Asn Tyr Thr Ile Gln Lys Thr Thr Ser Glu Ser Glu His
 50 55 60
 His Thr Ser Ser Pro Pro Thr Glu Ser Asn Lys Glu Thr Ser Thr Ile
 65 70 75 80
 Pro Ile Asp Asn Pro Asp Ile Asn Pro Asn Ser Gln His Pro Thr Gln
 85 90 95
 Gln Ser Thr Glu Ser Leu Thr Leu Asn Pro Ala Ala Ser Val Ser Pro
 100 105 110
 Ser Glu Thr Glu Pro Ala Ser Thr Pro Asp Thr Thr Asn Arg Leu Ser
 115 120 125
 Ser Val Asp Arg Ser Thr Thr Gln Pro Ser Glu Ser Arg Thr Lys Thr
 130 135 140
 Lys Leu Thr Val His Lys Lys Asn Ile Pro Ser Thr Val Ser Arg Thr
 145 150 155 160
 Gln Ser Ser Ile Arg Ala Thr Thr Lys Ala Val Leu Arg Ala Thr Ala
 165 170 175
 Phe Arg Thr Ser Ser Thr Gly Glu Arg Pro Thr Thr Thr Ser Val Gln
 180 185 190
 Ser Asp Ser Ser Thr Thr Thr Gln Asn His Glu Glu Thr Gly Ser Ala
 195 200 205
 Asn Pro Gln Ala Ser Ala Ser Thr Met Gln Asn Xaa His Thr Asn Ile
 210 215 220
 Val Lys Pro Asn
 225

<210> 132
 <211> 228
 <212> PRT
 <213> Human metapneumovirus

<220>
 <221> VARIANT
 <222> 220
 <223> Xaa = unknown amino acid or other

<400> 132

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Met Glu Val Lys Val Glu Asn Ile Arg Ala Ile Asp Met Leu Lys Ala
 1           5           10           15
Arg Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
          20           25           30
Leu Ile Leu Ile Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
          35           40           45
Leu Ile Ile Asn Tyr Thr Ile Gln Lys Thr Thr Ser Glu Ser Glu His
          50           55           60
His Thr Ser Ser Pro Pro Thr Glu Ser Asn Lys Glu Thr Ser Thr Ile
65           70           75           80
Ser Ile Asp Asn Pro Asp Ile Asn Pro Asn Ser Gln His Pro Thr Gln
          85           90           95
Gln Ser Thr Glu Ser Leu Thr Leu Ser Pro Thr Ala Ser Val Ser Pro
          100          105          110
Ser Glu Thr Glu Pro Ala Ser Thr Ser Asp Thr Thr Ser Arg Leu Ser
          115          120          125
Ser Val Asp Arg Ser Thr Thr Gln Pro Ser Glu Ser Arg Ala Arg Thr
          130          135          140
Lys Pro Thr Val His Lys Lys Asn Ile Pro Ser Thr Val Ser Arg Thr
145          150          155          160
Gln Ser Pro Leu Arg Ala Thr Thr Lys Ala Val Leu Arg Ala Thr Ala
          165          170          175
Phe Arg Thr Ser Ser Thr Gly Glu Gly Pro Thr Thr Thr Ser Val Gln
          180          185          190
Ser Asp Ser Ser Thr Thr Thr Gln Asn His Glu Glu Thr Gly Ser Ala
          195          200          205
Asn Pro Gln Ala Ser Ala Ser Thr Met Gln Asn Xaa His Thr Asn Ile
          210          215          220
Val Lys Pro Asn
225

```

<210> 133

<211> 228

<212> PRT

<213> Human metapneumovirus

<220>

<221> VARIANT

<222> 220

<223> Xaa = unknown amino acid or other

<400> 133

```

Met Glu Val Lys Val Glu Asn Ile Arg Ala Ile Asp Met Leu Lys Ala
 1           5           10           15
Arg Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
          20           25           30
Leu Ile Leu Ile Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
          35           40           45
Leu Ile Ile Asn Tyr Thr Ile Gln Lys Thr Thr Ser Glu Ser Glu His
          50           55           60
His Thr Ser Ser Pro Pro Thr Glu Ser Asn Lys Glu Ala Ser Thr Ile
65           70           75           80
Ser Thr Asp Asn Pro Asp Ile Asn Pro Asn Ser Gln His Pro Thr Gln
          85           90           95
Gln Ser Thr Glu Asn Pro Thr Leu Asn Pro Ala Ala Ser Val Ser Ser
          100          105          110
Ser Glu Thr Glu Pro Ala Ser Thr Pro Asp Thr Thr Asn Arg Leu Ser
          115          120          125
Ser Val Asp Arg Ser Thr Ala Gln Pro Ser Glu Ser Arg Thr Lys Thr

```

```

      130              135              140
Lys Pro Thr Val His Thr Arg Asn Asn Pro Ser Thr Ala Ser Ser Thr
145              150              155              160
Gln Ser Pro Pro Arg Val Thr Thr Lys Ala Ile Leu Arg Ala Thr Val
      165              170              175
Phe Arg Met Ser Ser Thr Gly Lys Arg Pro Ala Thr Thr Leu Val Gln
      180              185              190
Ser Asp Ser Ser Thr Thr Thr Gln Asn His Glu Glu Thr Gly Ser Ala
      195              200              205
Asn Ser Gln Ala Ser Ala Ser Thr Met Gln Asn Xaa His Ser Asn Asn
      210              215              220
Ile Lys Pro Asn
225

```

```

<210> 134
<211> 228
<212> PRT
<213> human metapneumo virus

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```

<400> 134
Met Glu Val Lys Val Glu Asn Ile Arg Ala Ile Asp Met Leu Lys Ala
 1              5              10              15
Arg Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
      20              25              30
Leu Ile Leu Ile Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
      35              40              45
Leu Ile Ile Asn Tyr Thr Ile Gln Lys Thr Thr Ser Glu Ser Glu His
      50              55              60
His Thr Ser Ser Pro Pro Thr Glu Ser Asn Lys Glu Thr Ser Thr Ile
      65              70              75              80
Ser Ile Asp Asn Ser Asp Ile Asn Pro Asn Ser Gln His Pro Thr Gln
      85              90              95
Gln Ser Thr Glu Ser Leu Thr Leu Ser Pro Thr Ala Ser Val Ser Pro
      100              105              110
Ser Glu Thr Glu Pro Ala Ser Thr Ser Asp Thr Thr Asn Arg Leu Ser
      115              120              125
Ser Val Asp Arg Ser Thr Thr Gln Pro Ser Glu Ser Arg Ala Arg Thr
      130              135              140
Lys Pro Thr Val His Lys Lys Asn Ile Pro Ser Thr Val Ser Arg Thr
      145              150              155              160
Gln Ser Pro Leu Arg Ala Thr Thr Lys Ala Val Leu Arg Ala Thr Ala
      165              170              175
Phe Arg Met Ser Ser Thr Gly Glu Gly Pro Thr Thr Thr Ser Val Gln
      180              185              190
Ser Asp Ser Ser Thr Thr Thr Gln Asn His Glu Glu Thr Gly Ser Ala
      195              200              205
Asn Pro Gln Ala Ser Ala Ser Thr Met Gln Asn Gln His Thr Asn Ile
      210              215              220
Ala Lys Pro Asn
225

```

```

<210> 135
<211> 228
<212> PRT
<213> human metapneumo virus

```

```

<400> 135
Met Glu Val Lys Val Glu Asn Ile Arg Ala Ile Asp Met Leu Lys Ala
 1              5              10              15

```

Arg Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
 20 25 30
 Leu Ile Leu Ile Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
 35 40 45
 Leu Ile Ile Asn Tyr Thr Ile Gln Lys Thr Thr Ser Glu Ser Glu His
 50 55 60
 His Thr Ser Ser Pro Pro Thr Glu Ser Asn Lys Glu Thr Ser Thr Ile
 65 70 75 80
 Pro Ile Asp Asn Pro Asp Ile Asn Pro Asn Ser Gln His Pro Thr Gln
 85 90 95
 Gln Ser Thr Glu Ser Leu Thr Leu Tyr Pro Thr Ser Ser Val Ser Ser
 100 105 110
 Ser Glu Thr Glu Pro Ala Ser Thr Pro Gly Ile Thr Asn His Leu Ser
 115 120 125
 Phe Val Asp Arg Ser Thr Thr Gln Pro Ser Glu Ser Arg Thr Lys Thr
 130 135 140
 Asn Arg Thr Val His Lys Lys Asn Ile Ser Ser Thr Val Ser Arg Thr
 145 150 155 160
 Gln Ser Pro Pro Arg Thr Thr Ala Lys Ala Val Pro Arg Ala Thr Ala
 165 170 175
 Leu Arg Thr Ser Ser Thr Gly Glu Arg Pro Thr Thr Thr Pro Val Gln
 180 185 190
 Pro Asp Ser Ser Thr Thr Thr Gln Asn His Glu Glu Thr Gly Ser Ala
 195 200 205
 Asn Pro Gln Ala Ser Ala Ser Thr Met Gln Asn Gln His Thr Asn Ile
 210 215 220
 Ala Arg Pro Asn
 225

<210> 136

<211> 228

<212> PRT

<213> human metapneumo virus

<400> 136

Met Glu Val Lys Val Glu Asn Ile Arg Ala Ile Asp Met Leu Lys Ala
 1 5 10 15
 Arg Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
 20 25 30
 Leu Ile Leu Ile Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
 35 40 45
 Leu Ile Ile Asn Tyr Thr Ile Gln Lys Thr Thr Ser Glu Ser Glu His
 50 55 60
 His Thr Ser Ser Pro Pro Thr Glu Ser Asn Lys Glu Thr Ser Thr Ile
 65 70 75 80
 Pro Ile Asp Asn Pro Asp Ile Asn Pro Asn Ser Gln His Pro Thr Gln
 85 90 95
 Gln Ser Ala Glu Ser Leu Thr Leu Tyr Pro Thr Ser Ser Val Ser Ser
 100 105 110
 Ser Glu Thr Glu Pro Ala Ser Thr Pro Gly Ile Thr Asn His Leu Ser
 115 120 125
 Phe Val Asp Arg Ser Thr Thr Gln Pro Ser Glu Ser Arg Thr Lys Thr
 130 135 140
 Asn Arg Thr Val His Lys Lys Asn Ile Ser Ser Thr Val Ser Arg Thr
 145 150 155 160
 Gln Ser Pro Pro Arg Thr Thr Ala Lys Ala Val Pro Arg Ala Thr Ala
 165 170 175
 Leu Arg Thr Ser Ser Thr Gly Glu Arg Pro Thr Thr Thr Pro Val Gln
 180 185 190
 Pro Asp Ser Ser Thr Thr Thr Gln Asn His Glu Glu Thr Gly Ser Ala

<400> 138															
Met	Glu	Val	Lys	Val	Glu	Asn	Ile	Arg	Ala	Ile	Asp	Met	Leu	Lys	Ala
1				5					10					15	
Arg	Val	Lys	Asn	Arg	Val	Ala	Arg	Ser	Lys	Cys	Phe	Lys	Asn	Ala	Ser
			20					25					30		
Leu	Ile	Leu	Ile	Gly	Ile	Thr	Thr	Leu	Ser	Ile	Ala	Leu	Asn	Ile	Tyr
		35					40					45			
Leu	Ile	Ile	Asn	Tyr	Thr	Ile	Gln	Gln	Thr	Thr	Ser	Glu	Ser	Glu	His
	50					55					60				
His	Thr	Ser	Ser	Pro	Pro	Thr	Glu	Ser	Asn	Lys	Glu	Ala	Ser	Thr	Ile
65					70					75					80

Ser Thr Asp Asn Pro Asp Ile Asn Pro Asn Ser Gln His Pro Thr Gln
 85 90 95
 Gln Ser Thr Glu Asn Pro Thr Leu Asn Pro Ala Ala Ser Ala Ser Pro
 100 105 110
 Ser Glu Thr Glu Ser Ala Ser Thr Pro Asp Thr Thr Asn Arg Leu Ser
 115 120 125
 Ser Val Asp Arg Ser Thr Val Gln Pro Ser Glu Asn Arg Thr Lys Thr
 130 135 140
 Lys Leu Thr Val His Thr Arg Asn Asn Leu Ser Thr Ala Ser Ser Thr
 145 150 155 160
 Gln Ser Pro Pro Arg Ala Thr Thr Lys Ala Ile Arg Arg Ala Thr Thr
 165 170 175
 Leu Arg Met Ser Ser Thr Gly Arg Arg Pro Thr Thr Thr Leu Val Gln
 180 185 190
 Ser Asp Ser Ser Thr Thr Thr Gln Asn His Glu Glu Thr Gly Ser Ala
 195 200 205
 Asn Pro Gln Ala Ser Ala Ser Thr Met Gln Asn Gln His Thr Asn Asn
 210 215 220
 Ile Lys Pro Asn
 225

<210> 139
 <211> 228
 <212> PRT
 <213> human metapneumo virus

<400> 139
 Met Glu Val Lys Val Glu Asn Ile Arg Ala Ile Asp Met Leu Lys Ala
 1 5 10 15
 Arg Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
 20 25 30
 Leu Ile Leu Ile Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
 35 40 45
 Leu Ile Ile Asn Tyr Thr Ile Gln Lys Thr Thr Ser Glu Ser Glu His
 50 55 60
 His Thr Ser Ser Pro Pro Thr Glu Ser Asn Lys Glu Ala Ser Thr Ile
 65 70 75 80
 Ser Thr Asp Asn Pro Asp Ile Asn Pro Asn Ser Gln His Pro Thr Gln
 85 90 95
 Gln Ser Thr Glu Asn Pro Thr Leu Asn Pro Ala Ala Ser Ala Ser Pro
 100 105 110
 Ser Glu Thr Glu Ser Ala Ser Thr Pro Asp Thr Thr Asn Arg Leu Ser
 115 120 125
 Ser Val Asp Arg Ser Thr Val Gln Pro Ser Glu Asn Arg Thr Lys Thr
 130 135 140
 Lys Leu Thr Val His Thr Arg Asn Asn Leu Ser Thr Ala Ser Ser Thr
 145 150 155 160
 Gln Ser Pro Pro Arg Ala Thr Thr Lys Ala Ile Arg Arg Ala Thr Thr
 165 170 175
 Leu Arg Met Ser Ser Thr Gly Arg Arg Pro Thr Thr Thr Leu Val Gln
 180 185 190
 Ser Asp Ser Ser Thr Thr Thr Gln Asn His Glu Glu Thr Gly Ser Ala
 195 200 205
 Asn Pro Gln Ala Ser Ala Ser Thr Met Gln Asn Gln His Thr Asn Asn
 210 215 220
 Ile Lys Pro Asn
 225

<210> 140

<211> 231
 <212> PRT
 <213> Human metapneumo virus

<220>
 <221> VARIANT
 <222> 225
 <223> Xaa = unknown amino acid or other

<400> 140
 Met Glu Val Arg Val Glu Asn Ile Arg Ala Ile Asp Met Phe Lys Ala
 1 5 10 15
 Lys Ile Lys Asn Arg Ile Arg Ser Ser Arg Cys Tyr Arg Asn Ala Thr
 20 25 30
 Leu Ile Leu Ile Gly Leu Thr Ala Leu Ser Met Ala Leu Asn Ile Phe
 35 40 45
 Leu Ile Ile Asp His Ala Thr Leu Arg Asn Met Ile Lys Thr Glu Asn
 50 55 60
 Cys Ala Asn Met Pro Ser Ala Glu Pro Ser Lys Lys Thr Pro Met Thr
 65 70 75 80
 Ser Thr Ala Gly Pro Asn Thr Lys Pro Asn Pro Gln Gln Ala Thr Gln
 85 90 95
 Trp Thr Thr Glu Asn Ser Thr Ser Pro Val Ala Thr Pro Glu Gly His
 100 105 110
 Pro Tyr Thr Gly Thr Thr Gln Thr Ser Asp Thr Thr Ala Pro Gln Gln
 115 120 125
 Thr Thr Asp Lys His Thr Ala Pro Leu Lys Ser Thr Asn Glu Gln Ile
 130 135 140
 Thr Gln Thr Thr Thr Glu Lys Lys Thr Ile Arg Ala Thr Thr Gln Lys
 145 150 155 160
 Arg Glu Lys Gly Lys Glu Asn Thr Asn Gln Thr Thr Ser Thr Ala Ala
 165 170 175
 Thr Gln Thr Thr Asn Thr Thr Asn Gln Ile Arg Asn Ala Ser Glu Thr
 180 185 190
 Ile Thr Thr Ser Asp Arg Pro Arg Thr Asp Thr Thr Thr Gln Ser Ser
 195 200 205
 Glu Gln Thr Thr Arg Ala Thr Asp Pro Ser Ser Pro Pro His His Ala
 210 215 220
 Xaa Arg Gly Ala Lys Leu Lys
 225 230

<210> 141
 <211> 231
 <212> PRT
 <213> human metapneumo virus

<400> 141
 Met Glu Val Arg Val Glu Asn Ile Arg Ala Ile Asp Met Phe Lys Ala
 1 5 10 15
 Lys Ile Lys Asn Arg Ile Arg Ser Ser Arg Cys Tyr Arg Asn Ala Thr
 20 25 30
 Leu Ile Leu Ile Gly Leu Thr Ala Leu Ser Met Ala Leu Asn Ile Phe
 35 40 45
 Leu Ile Ile Asp His Ala Thr Leu Arg Asn Met Ile Lys Thr Glu Asn
 50 55 60
 Cys Ala Asn Met Pro Ser Ala Glu Pro Ser Lys Lys Thr Pro Met Thr
 65 70 75 80
 Ser Thr Ala Gly Pro Ser Thr Glu Pro Asn Pro Gln Gln Ala Thr Gln
 85 90 95
 Trp Thr Thr Glu Asn Ser Thr Ser Pro Ala Ala Thr Leu Glu Ser His

Pro	Tyr	Thr	100	Thr	Thr	Gln	Thr	105	Pro	Asp	Ile	Thr	Ala	Pro	Gln	Gln
			115					120					125			
Thr	Thr	Asp	Lys	His	Thr	Ala	Leu	Pro	Lys	Ser	Thr	Asn	Glu	Gln	Ile	
			130					135					140			
Thr	Gln	Thr	Thr	Thr	Glu	Lys	Lys	Thr	Thr	Arg	Ala	Thr	Thr	Gln	Lys	
145					150					155					160	
Arg	Glu	Lys	Glu	Lys	Glu	Asn	Thr	Asn	Gln	Thr	Thr	Ser	Thr	Ala	Ala	
				165					170						175	
Thr	Gln	Thr	Thr	Asn	Thr	Thr	Asn	Gln	Thr	Arg	Asn	Ala	Ser	Glu	Thr	
				180				185					190			
Ile	Thr	Thr	Ser	Asp	Arg	Pro	Arg	Ile	Asp	Thr	Thr	Thr	Gln	Ser	Ser	
			195				200						205			
Asp	Gln	Thr	Thr	Arg	Ala	Thr	Asp	Pro	Ser	Ser	Pro	Pro	His	His	Ala	
			210			215						220				
Gln	Ser	Gly	Ala	Lys	Pro	Lys										
225						230										

<210> 142
 <211> 231
 <212> PRT
 <213> human metapneumo virus

Met	Glu	Val	Arg	Val	Glu	Asn	Ile	Arg	Ala	Ile	Asp	Met	Phe	Lys	Ala	
1				5					10					15		
Lys	Ile	Lys	Asn	Arg	Ile	Arg	Ser	Ser	Arg	Cys	Tyr	Arg	Asn	Ala	Thr	
			20					25					30			
Leu	Ile	Leu	Ile	Gly	Leu	Thr	Ala	Leu	Ser	Met	Ala	Leu	Asn	Ile	Phe	
			35				40					45				
Leu	Ile	Ile	Asp	His	Ala	Thr	Leu	Arg	Asn	Met	Ile	Lys	Thr	Glu	Asn	
			50			55					60					
Cys	Ala	Asn	Met	Pro	Pro	Ala	Glu	Pro	Ser	Lys	Lys	Thr	Pro	Met	Thr	
65				70					75						80	
Ser	Thr	Ala	Gly	Pro	Asn	Thr	Lys	Pro	Asn	Pro	Gln	Gln	Ala	Thr	Gln	
				85				90					95			
Trp	Thr	Thr	Glu	Asn	Ser	Thr	Phe	Pro	Ala	Ala	Thr	Ser	Glu	Gly	His	
			100					105					110			
Leu	His	Thr	Gly	Thr	Thr	Gln	Thr	Pro	Asp	Thr	Thr	Ala	Pro	Gln	Gln	
			115				120					125				
Thr	Thr	Asp	Lys	His	Thr	Ala	Leu	Pro	Lys	Ser	Thr	Asn	Glu	Gln	Ile	
			130			135					140					
Thr	Gln	Thr	Thr	Thr	Glu	Lys	Lys	Thr	Thr	Arg	Ala	Thr	Thr	Gln	Arg	
145					150					155					160	
Arg	Glu	Lys	Gly	Lys	Glu	Asn	Thr	Asn	Gln	Thr	Thr	Ser	Thr	Ala	Ala	
				165				170						175		
Thr	Gln	Thr	Thr	Asn	Thr	Thr	Asn	Gln	Ile	Arg	Asn	Ala	Ser	Glu	Thr	
			180				185					190				
Ile	Thr	Thr	Ser	Asp	Arg	Pro	Arg	Thr	Asp	Ser	Thr	Thr	Gln	Ser	Ser	
			195			200						205				
Glu	Gln	Thr	Thr	Arg	Ala	Thr	Asp	Pro	Ser	Ser	Pro	Pro	His	His	Ala	
			210			215					220					
Gln	Gly	Ser	Ala	Lys	Pro	Lys										
225						230										

<210> 143
 <211> 231
 <212> PRT
 <213> human metapneumo virus

<400> 143

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Met Glu Val Arg Val Glu Asn Ile Arg Ala Ile Asp Met Phe Lys Ala
 1           5           10           15
Lys Ile Lys Asn Arg Ile Arg Ser Ser Arg Cys Tyr Arg Asn Ala Thr
           20           25           30
Leu Ile Leu Ile Gly Leu Thr Ala Leu Ser Met Ala Leu Asn Ile Phe
           35           40           45
Leu Ile Ile Asp His Ala Thr Leu Arg Asn Met Ile Lys Thr Glu Asn
           50           55           60
Cys Ala Asn Met Pro Pro Ala Glu Pro Ser Arg Lys Thr Pro Met Thr
65           70           75           80
Ser Thr Ala Gly Pro Asn Thr Lys Pro Asn Pro Gln Gln Ala Thr Gln
           85           90           95
Trp Thr Thr Glu Asn Ser Thr Ser Pro Ala Ala Thr Pro Glu Gly His
           100          105          110
Leu His Thr Gly Thr Thr Gln Thr Pro Asp Thr Thr Ala Pro Gln Gln
           115          120          125
Thr Thr Asp Lys His Thr Ala Leu Pro Lys Ser Thr Asn Glu Gln Ile
           130          135          140
Thr Gln Ala Thr Thr Glu Lys Lys Thr Thr Arg Glu Thr Thr Gln Arg
145           150          155          160
Arg Glu Lys Gly Lys Glu Asn Thr Asn Gln Thr Thr Ser Thr Ala Ala
           165          170          175
Thr Gln Thr Thr Asn Thr Thr Asn Gln Ile Arg Asn Ala Ser Glu Thr
           180          185          190
Ile Thr Thr Ser Asp Arg Pro Arg Thr Asp Ser Thr Thr Gln Ser Ser
           195          200          205
Glu Gln Thr Thr Gln Ala Thr Asp Pro Ser Ser Pro Ala His His Ala
           210          215          220
Gln Gly Ser Ala Lys Pro Lys
225           230

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<210> 144

<211> 231

<212> PRT

<213> human metapneumo virus

<400> 144

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Met Glu Val Arg Val Glu Asn Ile Arg Ala Ile Asp Met Phe Lys Ala
 1           5           10           15
Lys Ile Lys Asn Arg Ile Arg Ser Ser Arg Cys Tyr Arg Asn Ala Thr
           20           25           30
Leu Ile Leu Ile Gly Leu Thr Ala Leu Ser Met Ala Leu Asn Ile Phe
           35           40           45
Leu Ile Ile Asp His Ala Thr Leu Arg Asn Met Ile Lys Thr Glu Asn
           50           55           60
Cys Ala Asn Met Pro Pro Ala Glu Pro Ser Lys Lys Thr Pro Met Thr
65           70           75           80
Ser Thr Ala Gly Leu Asn Thr Lys Pro Asn Pro Gln Gln Ala Thr Gln
           85           90           95
Trp Thr Thr Glu Asn Ser Thr Ser Pro Ala Ala Thr Pro Glu Gly His
           100          105          110
Leu His Thr Gly Thr Thr Gln Thr Pro Asp Thr Thr Ala Pro Gln Gln
           115          120          125
Thr Thr Asp Lys His Thr Ala Leu Pro Lys Ser Thr Asn Glu Gln Ile
           130          135          140
Thr Gln Thr Thr Thr Glu Lys Lys Thr Thr Arg Ala Thr Thr Gln Arg
145           150          155          160
Arg Glu Lys Gly Lys Glu Asn Thr Asn Gln Thr Thr Ser Thr Ala Ala

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				165					170					175			
Thr	Gln	Thr	Thr	Asn	Thr	Thr	Asn	Gln	Ile	Arg	Asn	Ala	Ser	Glu	Thr		
				180				185						190			
Ile	Thr	Thr	Ser	Asp	Arg	Pro	Arg	Thr	Asp	Ser	Thr	Thr	Gln	Ser	Ser		
			195				200						205				
Glu	Gln	Thr	Thr	Arg	Ala	Thr	Asp	Pro	Ser	Ser	Pro	Pro	His	His	Ala		
	210					215					220						
Gln	Gly	Ser	Ala	Lys	Pro	Lys											
225					230												

<210> 145
 <211> 231
 <212> PRT
 <213> human metapneumo virus

<400> 145
 Met Glu Val Arg Val Glu Asn Ile Arg Ala Ile Asp Met Phe Lys Ala
 1 5 10 15
 Lys Ile Lys Asn Arg Ile Arg Ser Ser Arg Cys Tyr Arg Asn Ala Thr
 20 25 30
 Leu Ile Leu Ile Gly Leu Thr Ala Leu Ser Met Ala Leu Asn Ile Phe
 35 40 45
 Leu Ile Ile Asp His Ala Thr Leu Arg Asn Met Ile Lys Thr Glu Asn
 50 55 60
 Cys Ala Asn Met Pro Pro Ala Glu Pro Ser Lys Lys Thr Pro Met Thr
 65 70 75 80
 Ser Thr Ala Gly Pro Asn Thr Lys Pro Asn Pro Gln Gln Ala Thr Gln
 85 90 95
 Trp Thr Thr Glu Asn Ser Thr Ser Pro Ala Ala Thr Pro Glu Gly His
 100 105 110
 Leu His Thr Gly Thr Thr Gln Thr Pro Asp Thr Thr Ala Pro Gln Gln
 115 120 125
 Thr Thr Asp Lys His Thr Ala Leu Pro Lys Ser Thr Asn Glu Gln Ile
 130 135 140
 Thr Gln Thr Thr Thr Glu Lys Lys Thr Thr Arg Ala Thr Thr Gln Arg
 145 150 155 160
 Arg Glu Lys Gly Lys Glu Asn Thr Asn Gln Thr Thr Ser Thr Ala Ala
 165 170 175
 Thr Gln Thr Thr Asn Thr Thr Asn Gln Ile Arg Asn Ala Ile Glu Thr
 180 185 190
 Ile Thr Thr Ser Asp Arg Pro Arg Thr Asp Ser Thr Thr Gln Ser Ser
 195 200 205
 Glu Gln Thr Thr Arg Ala Thr Asp Pro Ser Ser His Pro His His Ala
 210 215 220
 Gln Gly Ser Ala Lys Pro Lys
 225 230

<210> 146
 <211> 236
 <212> PRT
 <213> human metapneumo virus

<400> 146
 Met Glu Val Arg Val Glu Asn Ile Arg Ala Ile Asp Met Phe Lys Ala
 1 5 10 15
 Lys Met Lys Asn Arg Ile Arg Ser Ser Lys Cys Tyr Arg Asn Ala Thr
 20 25 30
 Leu Ile Leu Ile Gly Leu Thr Ala Leu Ser Met Ala Leu Asn Ile Phe
 35 40 45

```

Leu Ile Ile Asp Tyr Ala Met Leu Lys Asn Met Thr Lys Val Glu His
 50          55          60
Cys Val Asn Met Pro Pro Val Glu Pro Ser Lys Lys Thr Pro Met Thr
65          70          75          80
Ser Ala Val Asp Leu Asn Thr Lys Pro Asn Pro Gln Gln Ala Thr Gln
 85          90          95
Leu Ala Ala Glu Asp Ser Thr Ser Leu Ala Ala Thr Ser Glu Asp His
100          105          110
Leu His Thr Gly Thr Thr Pro Thr Pro Asp Ala Thr Val Ser Gln Gln
115          120          125
Thr Thr Asp Glu Tyr Thr Thr Leu Leu Arg Ser Thr Asn Arg Gln Thr
130          135          140
Thr Gln Thr Thr Thr Glu Lys Lys Pro Thr Gly Ala Thr Thr Lys Lys
145          150          155          160
Glu Thr Thr Thr Arg Thr Thr Ser Thr Ala Ala Thr Gln Thr Leu Asn
165          170          175
Thr Thr Asn Gln Thr Ser Tyr Val Arg Glu Ala Thr Thr Thr Ser Ala
180          185          190
Arg Ser Arg Asn Ser Ala Thr Thr Gln Ser Ser Asp Gln Thr Thr Gln
195          200          205
Ala Ala Asp Pro Ser Ser Gln Pro His His Thr Gln Lys Ser Thr Thr
210          215          220
Thr Thr Tyr Asn Thr Asp Thr Ser Ser Pro Ser Ser
225          230          235

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<210> 147

<211> 236

<212> PRT

<213> Human metapneumo virus

<220>

<221> VARIANT

<222> 220, 227

<223> Xaa = unknown amino acid or other

<400> 147

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Met Glu Val Arg Val Glu Asn Ile Arg Thr Ile Asp Met Phe Lys Ala
 1          5          10          15
Lys Met Lys Asn Arg Ile Arg Ser Ser Lys Cys Tyr Arg Asn Ala Thr
20          25          30
Leu Ile Leu Ile Gly Leu Thr Ala Leu Ser Met Ala Leu Asn Ile Phe
35          40          45
Leu Ile Ile Asp Tyr Ala Thr Phe Lys Asn Met Thr Lys Val Glu His
50          55          60
Cys Ala Asn Met Pro Pro Val Glu Pro Ser Lys Lys Thr Pro Met Thr
65          70          75          80
Ser Thr Val Asp Ser Ser Thr Gly Pro Asn Pro Gln Gln Thr Thr Gln
85          90          95
Trp Thr Thr Glu Asp Ser Thr Ser Leu Ala Ala Thr Ser Glu Asp His
100          105          110
Leu His Thr Gly Thr Thr Pro Thr Leu Asp Ala Thr Val Ser Gln Gln
115          120          125
Thr Pro Asp Lys His Thr Thr Pro Leu Arg Ser Thr Asn Gly Gln Thr
130          135          140
Thr Gln Thr Thr Thr Glu Lys Lys Pro Thr Arg Ala Ile Ala Lys Lys
145          150          155          160
Glu Thr Thr Asn Gln Thr Thr Ser Thr Ala Ala Thr Gln Thr Phe Asn
165          170          175
Thr Thr Asn Gln Thr Arg Asn Gly Arg Glu Thr Thr Ile Thr Ser Ala
180          185          190

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Arg Ser Arg Asn Asp Ala Thr Thr Gln Ser Ser Glu Gln Thr Asn Gln
 195 200 205
 Thr Thr Asp Pro Ser Ser Gln Pro His His Ala Xaa Ile Ser Thr Ile
 210 215 220
 Thr Ile Xaa Thr Gln His Arg His Ile Phe Ser Lys
 225 230 235

<210> 148

<211> 236

<212> PRT

<213> Human metapneumo virus

<220>

<221> VARIANT

<222> 208

<223> Xaa = unknown amino acid or other

<400> 148

Met Glu Val Arg Val Glu Asn Ile Arg Ala Ile Asp Met Phe Lys Ala
 1 5 10 15
 Lys Met Lys Asn Arg Ile Arg Ser Ser Lys Cys Tyr Arg Asn Ala Thr
 20 25 30
 Leu Ile Leu Ile Gly Leu Thr Ala Leu Ser Met Ala Leu Asn Ile Phe
 35 40 45
 Leu Ile Ile Asp Tyr Ala Met Leu Lys Asn Met Thr Lys Val Glu His
 50 55 60
 Cys Val Asn Met Pro Pro Val Glu Pro Ser Lys Lys Thr Pro Met Thr
 65 70 75 80
 Ser Ala Val Asp Leu Asn Thr Lys Leu Asn Pro Gln Gln Ala Thr Gln
 85 90 95
 Leu Thr Thr Glu Asp Ser Thr Ser Leu Ala Ala Thr Ser Glu Asp His
 100 105 110
 Leu Leu Thr Gly Thr Thr Pro Thr Pro Asp Ala Thr Val Ser Gln Gln
 115 120 125
 Thr Thr Asp Glu His Thr Thr Leu Leu Arg Ser Thr Asn Arg Gln Thr
 130 135 140
 Thr Gln Thr Thr Thr Glu Lys Lys Pro Thr Gly Ala Thr Thr Lys Lys
 145 150 155 160
 Glu Thr Thr Thr Arg Thr Thr Ser Thr Ala Ala Thr Gln Thr Leu Asn
 165 170 175
 Thr Thr Asn Gln Thr Ser Asn Gly Arg Glu Ala Thr Thr Thr Ser Thr
 180 185 190
 Arg Ser Arg Asn Gly Ala Thr Thr Gln Asn Ser Asp Gln Thr Thr Xaa
 195 200 205
 Thr Ala Asp Pro Ser Ser Gln Pro His His Thr Gln Lys Ser Thr Thr
 210 215 220
 Thr Thr Tyr Asn Thr Asp Thr Ser Ser Pro Ser Ser
 225 230 235

<210> 149

<211> 236

<212> PRT

<213> human metapneumo virus

<400> 149

Met Glu Val Arg Val Glu Asn Ile Arg Ala Ile Asp Met Phe Lys Ala
 1 5 10 15
 Lys Met Lys Asn Arg Ile Arg Ser Ser Lys Cys Tyr Arg Asn Ala Thr
 20 25 30
 Leu Ile Leu Ile Gly Leu Thr Ala Leu Ser Met Ala Leu Asn Ile Phe

```

      35              40              45
Leu Ile Ile Asp Tyr Ala Thr Leu Lys Asn Met Thr Lys Val Glu His
      50              55              60
Cys Val Asn Met Pro Pro Val Glu Pro Ser Lys Lys Thr Pro Met Thr
65      70              75              80
Ser Ala Val Asp Leu Asn Thr Lys Leu Asn Pro Gln Gln Ala Thr Gln
      85              90              95
Leu Thr Thr Glu Asp Ser Thr Ser Leu Ala Ala Thr Ser Glu Gly His
      100             105             110
Pro His Thr Gly Thr Thr Pro Thr Pro Asp Ala Thr Val Ser Gln Gln
      115             120             125
Thr Thr Asp Glu His Thr Thr Leu Leu Arg Ser Thr Asn Arg Gln Thr
      130             135             140
Thr Gln Thr Ala Thr Glu Lys Lys Pro Thr Gly Ala Thr Thr Lys Lys
145      150             155             160
Glu Thr Thr Thr Arg Thr Thr Ser Thr Ala Ala Thr Gln Thr Pro Asn
      165             170             175
Thr Thr Asn Gln Thr Ser Asn Gly Arg Glu Ala Thr Thr Thr Ser Ala
      180             185             190
Arg Ser Arg Asn Gly Ala Thr Thr Gln Asn Ser Asp Gln Ile Thr Gln
      195             200             205
Ala Ala Asp Ser Ser Ser Gln Pro His His Thr Gln Lys Ser Thr Thr
      210             215             220
Thr Ala Tyr Asn Thr Asp Thr Ser Phe Pro Ser Ser
225      230             235

```

<210> 150

<211> 236

<212> PRT

<213> human metapneumo virus

<400> 150

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Met Glu Val Arg Val Glu Asn Ile Arg Ala Ile Asp Met Phe Lys Ala
1      5      10      15
Lys Met Lys Asn Arg Ile Arg Ser Ser Lys Cys Tyr Arg Asn Ala Thr
      20      25      30
Leu Ile Leu Ile Gly Leu Thr Ala Leu Ser Met Ala Leu Asn Ile Phe
      35      40      45
Leu Ile Ile Asp Tyr Ala Thr Leu Lys Asn Met Thr Lys Val Glu His
      50      55      60
Cys Val Asn Met Pro Pro Val Glu Pro Ser Lys Lys Thr Pro Met Thr
65      70      75      80
Ser Ala Val Asp Ser Asn Thr Lys Pro Asn Pro Gln Gln Ala Thr Gln
      85      90      95
Leu Thr Thr Glu Asp Ser Thr Ser Leu Ala Ala Thr Leu Glu Asp His
      100     105     110
Pro His Thr Gly Thr Thr Pro Thr Pro Asp Ala Thr Val Ser Gln Gln
      115     120     125
Thr Thr Asp Glu His Thr Thr Leu Leu Arg Ser Thr Asn Arg Gln Thr
      130     135     140
Thr Gln Thr Thr Ala Glu Lys Lys Pro Thr Arg Ala Thr Thr Lys Lys
145     150     155     160
Glu Thr Thr Thr Arg Thr Thr Ser Thr Ala Ala Thr Gln Thr Leu Asn
      165     170     175
Thr Thr Asn Gln Thr Ser Asn Gly Arg Glu Ala Thr Thr Thr Ser Ala
      180     185     190
Arg Ser Arg Asn Asn Ala Thr Thr Gln Ser Ser Asp Gln Thr Thr Gln
      195     200     205
Ala Ala Glu Pro Ser Ser Gln Ser Gln His Thr Gln Lys Ser Thr Thr
210     215     220

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Thr Thr Tyr Asn Thr Asp Thr Ser Ser Leu Ser Ser
 225 230 235

<210> 151
 <211> 236
 <212> PRT
 <213> human metapneumo virus

<400> 151
 Met Glu Val Arg Val Glu Asn Ile Arg Ala Ile Asp Met Phe Lys Ala
 1 5 10 15
 Lys Met Lys Asn Arg Ile Arg Ser Ser Lys Cys Tyr Arg Asn Ala Thr
 20 25 30
 Leu Ile Leu Ile Gly Leu Ser Ala Leu Ser Met Ala Leu Asn Ile Phe
 35 40 45
 Leu Ile Ile Asp Tyr Ala Lys Ser Lys Asn Met Thr Arg Val Glu His
 50 55 60
 Cys Val Asn Met Pro Pro Val Glu Pro Ser Lys Lys Thr Pro Met Thr
 65 70 75 80
 Ser Ala Val Asp Leu Asn Thr Lys Pro Asn Pro Gln Arg Ala Thr Gln
 85 90 95
 Leu Thr Thr Glu Asp Ser Thr Ser Leu Ala Ala Thr Leu Glu Gly His
 100 105 110
 Leu His Thr Gly Thr Thr Pro Thr Pro Asp Val Thr Val Ser Gln Gln
 115 120 125
 Thr Thr Asp Glu His Thr Thr Leu Leu Arg Ser Thr Asn Arg Gln Thr
 130 135 140
 Thr Gln Thr Ala Ala Glu Lys Lys Pro Thr Arg Val Thr Thr Asn Lys
 145 150 155 160
 Glu Thr Ile Thr Arg Thr Thr Ser Thr Ala Ala Thr Gln Thr Leu Asn
 165 170 175
 Thr Thr Asn Gln Thr Asn Asn Gly Arg Glu Ala Thr Thr Thr Ser Ala
 180 185 190
 Arg Ser Arg Asn Asn Ala Thr Thr Gln Ser Ser Asp Gln Thr Thr Gln
 195 200 205
 Ala Ala Asp Pro Ser Ser Gln Ser Gln His Thr Gln Lys Ser Ile Thr
 210 215 220
 Thr Thr Tyr Asn Thr Asp Thr Ser Ser Pro Ser Ser
 225 230 235

<210> 152
 <211> 236
 <212> PRT
 <213> human metapneumo virus

<400> 152
 Met Glu Val Arg Val Glu Asn Ile Arg Ala Ile Asp Met Phe Lys Ala
 1 5 10 15
 Lys Met Lys Asn Arg Ile Arg Ser Ser Lys Cys Tyr Arg Asn Ala Thr
 20 25 30
 Leu Ile Leu Ile Gly Leu Ser Ala Leu Ser Met Ala Leu Asn Ile Phe
 35 40 45
 Leu Ile Ile Asp Tyr Ala Lys Ser Lys Thr Met Thr Arg Val Glu His
 50 55 60
 Cys Val Asn Met Pro Pro Val Glu Pro Ser Lys Lys Thr Pro Met Thr
 65 70 75 80
 Ser Ala Val Asp Leu Asn Thr Lys Pro Asn Pro Gln Gln Ala Thr Gln
 85 90 95
 Leu Thr Thr Glu Asp Ser Thr Ser Pro Ala Ala Thr Leu Glu Gly His

```
<210> 153
<211> 236
<212> PRT
<213> human metapneumo virus
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<210> 154
<211> 449
<212> DNA
<213> human metapneumo virus
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<400> 154
ataggagttt acggaagctc cgtaattttac atggtgcaac tgccaatctt tgggggttata 60
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<210> 181

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 181

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gcttgccctc taagagaaga tcaaggatgg tattgtcaga atgcaggggc aactgtttac 180
taccctaatg aaaaagactg cgaaacaaga ggagaccatg tcttttgca cacagcagca 240
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ccatgcaaag ttagcacagg aagacatcct atcagtatgg ttgcaactgtc tcctcttggg 360
gctttggttg cttgctacaa gggagtggagc tgttccattg gcagcaacag agtagggatc 420
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<210> 182

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 182

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gcttgccctc taagagaaga ccaaggatgg tattgtcaaa atgcaggggc aactgtttac 180
taccctaatg aaaaagactg tgaacaaga ggagaccatg tcttttgca cacagcagca 240
ggaatcaatg ttgctgagca gtcaaaggag tgcaacataa acatatctac tactaattac 300

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ccatgcaaag ttagcacagg aagacatcct atcagtatgg ttgcactatc tcctcttggg 360
gcttttggtt cttgctacaa gggagtggagc tgttccattg gcagcaacag agtagggatc 420
atcaagcaac tgaacaaagg ctgctctta 449

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<210> 183

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 183

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gcttgccctt taagagaaga ccaagggtgg tattgtcaga atgcagggtc aactgtttac 180
taccctaatg agaaagactg tgaaacaaga ggagaccatg tcttttgcga cacagcagca 240
ggaattaatg ttgctgagca atcaaaaggag tgcaacatca acatatccac taaaaattac 300
ccatgcaaag tcagcacagg aagacatcct atcagtatgg ttgcactgtc ccctcttggg 360
gctctggttg cttgctacaa aggagtaagc tgttccattg gcagcaatag agtagggatt 420
atcaagcagc tgaacaaagg ttgctctta 449

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<210> 184

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 184

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gcttgccctt taagagaaga tcaagggtgg tattgtcaga atgcagggtc aactgtttac 180
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gctctagttg cttgctacaa aggagtaagc tgttccattg gcagcaatag agtagggatc 420
atcaagcagc tgaacaaagg ttgctccta 449

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<210> 185

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 185

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gcttgccctt taagagaaga tcaagggtgg tattgtcaga atgcagggtc aactgtttac 180
taccctaatg agaaagactg tgaaacaaga ggagaccatg tcttttgcga cacagtagca 240
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atcaagcagc tgaacaaagg ttgctccta 449

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<210> 186

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 186

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gcttgccctt taagagaaga tcaagggtgg tattgtcaga atgcagggtc aactgtttac 180
taccctaatg agaaagactg tgaaacaaga ggagaccatg tcttttgcga cacagcagca 240
ggaattaatg ttgctgagca atcaaaagag tgcaacatca acatatccac taaaaattac 300
ccatgcaaag tcagcacagg aagacatcct atcagtatgg ttgcactgtc ccctcttggg 360

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gctctagttg cttgctacaa aggagtaagc tgttccattg gcagcaatag agtagggatc 420
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<210> 187

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 187

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 gcttgccctc taagagaaga ccaagggtgg tattgtcaga atgcagggtc aactgtttac 180
 taccctaatg agaaggactg tgaacaaga ggagaccatg tcttttgca cacagcagca 240
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 ccatgcaaag tcagcacagg aaggcatcct atcagtatgg ttgcaactgtc ccctcttggg 360
 gctctggttg cttgttataa aggagtaagc tgttctattg gcagcaatag agtagggatc 420
 atcaagcagc tgaacaaagg ttgctccta 449

<210> 188

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 188

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 gcttgccctc taagagaaga ccaagggtgg tattgtcaga atgcagggtc aactgtttac 180
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 ccatgcaaag tcagcacagg aagacatcct atcagtatgg ttgcaactgtc tcctcttggg 360
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<210> 189

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 189

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 ccatgcaaag tcagcacagg aaggcatcct atcagtatgg ttgcaactgtc ccctcttggg 360
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<210> 190

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 190

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 taccctaatg agaaggactg tgaacaaga ggagaccatg tcttttgca cacagcagca 240
 ggaattaatg ttgctgagca atcaaaggag tgcaacatca acatatccac tacaattac 300
 ccatgcaaag tcagcacagg aagacatcct atcagtatgg ttgcaactgtc tcctcttggg 360
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atcaagcagc tgaacaaagg ttgctccta

449

<210> 191

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<212> DNA

<213> human metapneumo virus

<400> 191

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gcttgccctc taagagaaga ccaagggtgg tattgtcaga atgcagggtc aactgtttac 180
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ccatgcaaag tcagcacagg aagacatcct atcagtatgg ttgactgtc tcctcttggg 360
gctctgggtg cttgctacaa aggagtaagc tgttccattg gcagcaacag agtagggatc 420
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<210> 192

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 192

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gctctgggtg cctgttacaa aggagtaagt tgttccattg gcagcaatag agtagggatc 420
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<210> 193

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 193

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<210> 194

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 194

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gcttgccctc taagagaaga ccaaggatgg tattgtcaga atgcagggtc aactgtttac 180
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 gctctggttg cttgctacaa aggagtaagc tgttccattg gcagcaacag agtagggatc 420
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<210> 198
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<210> 203

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<212> DNA

<213> human metapneumo virus

<400> 203

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<210> 204

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<212> DNA

<213> human metapneumo virus

<400> 204

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<210> 205

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 205

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<210> 206

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 206

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gctttggtgg cttgctataa aggggtaagc tgctcgattg gcagcaatcg ggttggaatc 420
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<210> 207

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 207

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ccatgcaaag tcagcacagg aagacaccct ataagcatgg ttgcactatc acctctcggg 360
gctttgggtgg cttgctataa aggggtaagc tgctcgattg gcagcaatcg ggttggaatc 420
atcaaacaat tacctaaagg ctgctcata 449

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<210> 208

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 208

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gcttgccctcc taagagagga tcaaggggtgg tactgtaaaa atgcaggatc cactgtttac 180
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gctttgggtgg cttgctataa aggggtaagc tgctcgattg gcagcaatcg ggttggaatc 420
atcaaacaat tacctaaagg ctgctcata 449

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<210> 209

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 209

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gcttgccctcc taagagagga tcaaggggtgg tattgtaaaa atgcaggatc cactgtttac 180
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ccatgcaaag tcagcacagg aagacaccct ataagcatgg ttgcactatc acctctcggg 360
gctttgggtgg cttgctataa aggggtaagc tgctcgattg gcagcaatcg ggttggaatc 420
atcaaacaat taccctaaagg ctgctcata 449

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<210> 210

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 210

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gcttgccctcc taagagagga tcaaggggtgg tattgtaaaa atgcaggatc cactgtttac 180
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gctttgggtgg cttgctataa aggggtaagc tgctcgattg gcagcaatcg ggttggaatt 420
atcaaacaat tacctaaagg ctgctcata 449

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<210> 211

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 211

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gatacacctt gttggataat caaggcagct ccctcttgct cagagaaaaa cgggaattat 120
gcttgccctc taagagagga tcaaggggtgg tattgtaaaa atgcaggatc cactgtttac 180
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gctttggtgg cttgctataa aggggtaagc tgctcgattg gcagcaatcg ggttggaatc 420
atcaaacaat tacctaaagg ctgctcata 449

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<210> 212

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 212

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gcttgccctc taagagagga tcaaggggtgg tattgtaaaa atgcaggatc cactgtttac 180
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ccatgcaaag tcagcacagg aagacaccct ataagcatgg ttgcactatc acctctcggt 360
gctttggtgg cttgctataa aggggtaagc tgctcgattg gcagcaatcg ggttggaatc 420
atcaaacaat tacctaaagg ctgctcata 449

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<210> 213

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 213

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gcttgccctc taagagagga tcaaggggtgg tattgtaaaa atgcaggatc cactgtttac 180
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gctttggtgg cttgctataa aggggtaagc tgctcgattg gcagcaatcg ggttggaatc 420
atcaaacaat tacctaaagg ctgctcata 449

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<210> 214

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 214

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gcttgccctc taagagagga tcaaggggtgg tattgtaaaa atgcaggatc cactgtttac 180
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gctttggtgg cttgctataa aggggtaagc tgctcgattg gcagcaatcg ggttggaatc 420
atcaaacaat tacctaaagg ctgctcata 449

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<210> 215

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 215

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gcttgctctc taagagagga tcaaggggtg tattgtaaaa atgcaggatc cactgtttac 180
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ccatgcaaag tcagcacagg aagacaccct ataagcatgg ttgcactatc acctctcggg 360
gctttggtgg cttgctataa aggggtaagc tgctcgattg gcagcaatcg gggttgaatc 420
atcaacaat taccctaaagg ctgctcata 449

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<210> 216

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 216

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gcttgctctc taagagagga tcaaggggtg tactgtaaaa atgcaggatc cactgtttac 180
taccctaatg aaaaagactg cgaaacaaga ggtgatcatg ttttttgtga cacagcagca 240
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ccatgcaaag tcagcacagg aagacaccct ataagcatgg ttgcactatc acctctcggg 360
gctttggtgg cttgctataa aggggtaagc tgctcgattg gcagcaatcg gggttgaatc 420
atcaacaat tacctaaagg ctgctcata 449

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<210> 217

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 217

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gcttgctctc taagagagga tcaaggggtg tattgcaaaa atgcaggatc cactgtttac 180
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ccatgcaaag tcagcacagg aagacaccct atcagcatgg ttgcactatc acctctcggg 360
gctttggtag cttgctataa gggggttagc tgctcgattg gcagtaatcg gggttgaata 420
atcaacaac tacctaaagg ctgctcata 449

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<210> 218

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 218

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gcttgctctc taagagagga tcaaggggtg tattgtaaaa atgcaggatc cactgtttac 180
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gctttggtag cttgctataa agggggttagc tgctcgattg gcagtaatcg gggttgaata 420
atcaacaac tacctaaagg ctgctcata 449

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<210> 219

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 219
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 gcttgccctcc taagagagga tcaaggggtgg tattgtaaaa atgcaggatc cactgtttac 180
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 gctttggttag cttgctacaa aggggttagc tgctcgattg gcagtaatcg ggttggaata 420
 atcaacaac tacctaaagg ctgctcata 449

<210> 220

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 220
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 gcttgccctcc taagagagga ccaaggggtgg tattgtaaaa atgcgggatc cactgtttac 180
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 gctttggttag cttgctacaa aggggttagc tgctcgattg gcagtaatcg ggttggaata 420
 atcaacaac tacctaaagg ctgctcata 449

<210> 221

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 221
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 gcttgccctcc taagagagga tcaaggggtgg tattgtaaaa atgcaggatc cactgtttac 180
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 ccatgcaaag tcagcacagg aagacaccct atcagcatgg ttgcactgtc acctctcggt 360
 gctttggttag cttgctacaa aggggttagc tgctcgattg gcagtaatcg ggttggaata 420
 atcaacaac tacctaaagg ctgctcata 449

<210> 222

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 222
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 ccatgcaaag tcagcacagg aagacaccct atcagcatgg ttgcactatc acctctcggt 360
 gctttggttag cttgctacaa aggggttagc tgctcgattg gcagtaatcg ggttggaata 420
 atcaacaac tacctaaagg ctgctcata 449

<210> 223

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 223

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gcttgccctcc taagagagga tcaaggggtgg tattgtaaaa atgcaggatc cactgtttac 180
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gctttggtag cttgctacaa aggggttagc tgttcgattg gcagtaatcg ggttggaata 420
atcaaacaac tacctaaagg ctgctcata 449

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<210> 224

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 224

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ataggggtct acggaagctc cgtgatttac atgggtccagc tgccgatctt tgggtgtcata 60
gatacacctt gttggataat caaggcagct cctctctgtt cagaaaaaga tggaaattat 120
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gctttggtag cttgctacaa aggggttagc tgttcgattg gcagtaatcg ggttggaata 420
atcaaacaac tacctaaagg ctgctcata 449

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<210> 225

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 225

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gctttggtag cttgctacaa aggggttagc tgttcgattg gcagtaatcg ggttggaata 420
atcaaacaac tacctaaagg ctgctcata 449

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<210> 226

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 226

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ataggggtct acggaagctc cgtgatttac atgggtccagc tgccgatctt tgggtgtcata 60
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gctttggtag cttgctacaa aggggttagc tgttcgattg gcagtaatcg ggttggaata 420
atcaaacaac tacctaaagg ctgctcata 449

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<210> 227

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 227

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ataggggtct acggaagctc cgtgatttac atgggtccagc tgccgatctt tgggtgtcata 60

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gctttggttag cttgctacaa aggggttagc tgttcaattg gcagtaatcg ggttggaata 420
atcaacaac tacctaaagg ctgctcata 449

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<210> 228

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 228

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gctttggttag cttgctacaa aggggttagc tgttcaattg gcagtaatcg ggttggaata 420
atcaacaac tacctaaagg ctgctcata 449

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<210> 229

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 229

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ataggggtct acggaagctc cgtgatttac atgggtccagc tgccgatctt tgggtgtcata 60
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gctttggttag cttgctacaa ggggttagc tgttcgattg gcagtaatcg ggttggaata 420
atcaacaac tacctaaagg ctgctcata 449

```

<210> 230

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 230

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gcttgccctcc taagagagga tcaaggggtgg tattgtaaaa atgcaggatc cactgtttac 180
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gctttggttag cttgctacaa aggggttagc tgttcgattg gcagtaatcg ggttggaata 420
atcaacaac tacctaaagg ctgctcata 449

```

<210> 231

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 231

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ataggggtct acggaagctc tgtgatttac atgggtccagc tgccgatctt tgggtgtcata 60
gatacacctt gttggataat caaggcagct ccctcttggt cagaaaaaga tggaaattat 120

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gcttgccctcc taagagagga tcaaggggtgg tattgtaaaa atgcaggatc cactgtttac 180
taccctaaatg aaaaagactg cgaacaaga ggtgatcatg ttttttgtga cacagcagca 240
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ccgtgcaaag tcagcacagg aagacaccct atcagcatgg ttgcactatc acctctcggg 360
gctttggttag cttgctacaa aggggttagc tgctcgattg gcagtaatcg ggttggaata 420
atcaacaac tacctaaagg ctgctcata 449

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<210> 232

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 232

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gcttgccctcc taagagagga tcaaggggtgg tattgtaaaa atgcaggatc cactgtttac 180
taccctaaatg aaaaagactg cgaacaaga ggtgatcatg ttttttgtga cacagctgca 240
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ccatgcaaag tcagcacagg aagacaccct atcagcatgg ttgcactatc acctctcggg 360
gctttggttag cttgctacaa aggggttagc tggtcaattg gcagtaatcg ggttggaata 420
atcaacaac tacctaaagg ctgctcata 449

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<210> 233

<211> 449

<212> DNA

<213> human metapneumo virus

<400> 233

```

ataggggtct acggaagctc cgtgatttac atgggtccagc tgccgatctt tgggtgtcata 60
gatacacctt gttggataat caaggcagct ccctcttggt cagaaaaaga tggaaattat 120
gcttgccctcc taagagagga tcaaggggtgg tattgtaaaa atgcaggatc cactgtttac 180
taccctaaatg aaaaagactg cgaacaaga ggtgatcatg ttttttgtga cacagcagca 240
gggatcaatg ttgctgagca atcaagagaa tgcaacatca acatatctac aaccaactac 300
ccatgcaaag tcagcacagg aagacaccct atcagcatgg ttgcactatc acctctcggg 360
gctttggttag cttgctacaa aggggttagc tggtcgattg gcagtaatcg ggttggaata 420
atcaacaac tacctaaagg ctgctcata 449

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<210> 234

<211> 149

<212> PRT

<213> human metapneumo virus

<400> 234

```

Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
20          25          30
Cys Ser Gly Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
35          40          45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
50          55          60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65          70          75          80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
85          90          95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
100         105         110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
115         120         125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
130         135         140

```

Asn Lys Gly Cys Ser
145

<210> 235
<211> 149
<212> PRT
<213> human metapneumo virus

<400> 235
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
1 5 10 15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
20 25 30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
35 40 45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
50 55 60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65 70 75 80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
85 90 95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
100 105 110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
115 120 125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
130 135 140
Asn Lys Gly Cys Ser
145

<210> 236
<211> 149
<212> PRT
<213> human metapneumo virus

<400> 236
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
1 5 10 15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
20 25 30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
35 40 45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
50 55 60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65 70 75 80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
85 90 95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
100 105 110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
115 120 125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
130 135 140
Asn Lys Gly Cys Ser
145

<210> 237

<211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 237
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Asn Lys Gly Cys Ser
 145

<210> 238
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 238
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Asn Lys Gly Cys Ser
 145

<210> 239
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 239


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Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
           20           25           30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
           35           40           45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
           50           55           60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65           70           75           80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
           85           90           95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
           100          105          110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
           115          120          125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
           130          135          140
Asn Lys Gly Cys Ser
145

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<210> 240
<211> 149
<212> PRT
<213> human metapneumo virus

```

```

<400> 240
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
           20           25           30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
           35           40           45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
           50           55           60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65           70           75           80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
           85           90           95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
           100          105          110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
           115          120          125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
           130          135          140
Asn Lys Gly Cys Ser
145

```

```

<210> 241
<211> 149
<212> PRT
<213> human metapneumo virus

```

```

<400> 241
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
           20           25           30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln

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```

      35              40              45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
  50              55              60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
  65              70              75              80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
      85              90              95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
      100              105              110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
      115              120              125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
      130              135              140
Asn Lys Gly Cys Ser
145

```

<210> 242
 <211> 149
 <212> PRT
 <213> human metapneumo virus

```

<400> 242
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
  1              5              10              15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
      20              25              30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
      35              40              45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
      50              55              60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
      65              70              75              80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
      85              90              95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
      100              105              110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
      115              120              125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
      130              135              140
Asn Lys Gly Cys Ser
145

```

<210> 243
 <211> 149
 <212> PRT
 <213> human metapneumo virus

```

<400> 243
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
  1              5              10              15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
      20              25              30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
      35              40              45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
      50              55              60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
      65              70              75              80

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Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Asn Lys Gly Cys Ser
 145

<210> 244
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 244
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Asn Lys Gly Cys Ser
 145

<210> 245
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 245
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly

115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Asn Lys Gly Cys Ser
 145

<210> 246
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 246
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Asn Lys Gly Cys Ser
 145

<210> 247
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 247
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Arg Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Asn Lys Gly Cys Ser
 145

<210> 248
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 248
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Asn Lys Gly Cys Ser
 145

<210> 249
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 249
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Asn Lys Gly Cys Ser
 145

<210> 250
 <211> 149
 <212> PRT

<213> human metapneumo virus

<400> 250

```

Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
           20           25           30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
           35           40           45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
           50           55           60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65           70           75           80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
           85           90           95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
           100          105          110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
           115          120          125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
           130          135          140
Asn Lys Gly Cys Ser
145

```

<210> 251

<211> 149

<212> PRT

<213> human metapneumo virus

<400> 251

```

Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
           20           25           30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
           35           40           45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
           50           55           60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65           70           75           80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
           85           90           95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
           100          105          110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
           115          120          125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
           130          135          140
Asn Lys Gly Cys Ser
145

```

<210> 252

<211> 149

<212> PRT

<213> human metapneumo virus

<400> 252

```

Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1           5           10           15

```

Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Asn Lys Gly Cys Ser
 145

<210> 253
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 253
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Asn Lys Gly Cys Ser
 145

<210> 254
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 254
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Gly Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu

```

      50              55              60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65              70              75              80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
      85              90              95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
      100             105             110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
      115             120             125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
      130             135             140
Asn Lys Gly Cys Ser
145

```

<210> 255
 <211> 149
 <212> PRT
 <213> human metapneumo virus

```

<400> 255
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1              5              10              15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
      20              25              30
Cys Ser Gly Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
      35              40              45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
      50              55              60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65              70              75              80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
      85              90              95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
      100             105             110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
      115             120             125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
      130             135             140
Asn Lys Gly Cys Ser
145

```

<210> 256
 <211> 149
 <212> PRT
 <213> human metapneumo virus

```

<400> 256
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1              5              10              15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
      20              25              30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
      35              40              45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
      50              55              60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65              70              75              80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
      85              90              95

```



```

Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
      100                      105                      110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
      115                      120                      125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
      130                      135                      140
Asn Lys Gly Cys Ser
145

```

<210> 257
 <211> 149
 <212> PRT
 <213> human metapneumo virus

```

<400> 257
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
1      5      10      15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
      20      25      30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
      35      40      45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
      50      55      60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65      70      75      80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
      85      90      95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
      100     105     110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
      115     120     125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
      130     135     140
Asn Lys Gly Cys Ser
145

```

<210> 258
 <211> 149
 <212> PRT
 <213> human metapneumo virus

```

<400> 258
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
1      5      10      15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
      20      25      30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
      35      40      45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
      50      55      60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65      70      75      80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
      85      90      95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
      100     105     110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
      115     120     125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu

```

130
Asn Lys Gly Cys Ser
145

135

140

<210> 259
<211> 149
<212> PRT
<213> human metapneumo virus

<400> 259
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
1 5 10 15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
20 25 30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
35 40 45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
50 55 60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65 70 75 80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
85 90 95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
100 105 110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
115 120 125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
130 135 140
Asn Lys Gly Cys Ser
145

<210> 260
<211> 149
<212> PRT
<213> human metapneumo virus

<400> 260
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
1 5 10 15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
20 25 30
Cys Ser Gly Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
35 40 45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
50 55 60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65 70 75 80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
85 90 95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
100 105 110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
115 120 125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
130 135 140
Asn Lys Gly Cys Ser
145

<210> 261
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 261

```

Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
           20           25           30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
           35           40           45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50           55           60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65           70           75           80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
           85           90           95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
           100          105          110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
           115          120          125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
           130          135          140
Asn Lys Gly Cys Ser
145
  
```

<210> 262
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 262

```

Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
           20           25           30
Cys Ser Gly Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
           35           40           45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50           55           60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65           70           75           80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
           85           90           95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
           100          105          110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
           115          120          125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
           130          135          140
Asn Lys Gly Cys Ser
145
  
```

<210> 263
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 263

```

Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
           20           25           30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
           35           40           45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
           50           55           60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65           70           75           80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
           85           90           95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
           100          105          110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
           115          120          125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
           130          135          140
Asn Lys Gly Cys Ser
145

```

<210> 264

<211> 149

<212> PRT

<213> human metapneumo virus

<400> 264

```

Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
           20           25           30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
           35           40           45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
           50           55           60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65           70           75           80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
           85           90           95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
           100          105          110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
           115          120          125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
           130          135          140
Asn Lys Gly Cys Ser
145

```

<210> 265

<211> 149

<212> PRT

<213> human metapneumo virus

<400> 265

```

Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
           20           25           30

```

Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Val Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Asn Lys Gly Cys Ser
 145

<210> 266
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 266
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Asn Lys Gly Cys Ser
 145

<210> 267
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 267
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala

65					70					75				80	
Gly	Ile	Asn	Val	Ala	Glu	Gln	Ser	Lys	Glu	Cys	Asn	Ile	Asn	Ile	Ser
				85					90					95	
Thr	Thr	Asn	Tyr	Pro	Cys	Lys	Val	Ser	Thr	Gly	Arg	His	Pro	Ile	Ser
			100					105					110		
Met	Val	Ala	Leu	Ser	Pro	Leu	Gly	Ala	Leu	Val	Ala	Cys	Tyr	Lys	Gly
		115					120					125			
Val	Ser	Cys	Ser	Ile	Gly	Ser	Asn	Arg	Val	Gly	Ile	Ile	Lys	Gln	Leu
	130					135					140				
Asn	Lys	Gly	Cys	Ser											
145															

<210> 268

<211> 149

<212> PRT

<213> human metapneumo virus

<400> 268

Ile	Gly	Val	Tyr	Gly	Ser	Ser	Val	Ile	Tyr	Met	Val	Gln	Leu	Pro	Ile
1				5					10					15	
Phe	Gly	Val	Ile	Asp	Thr	Pro	Cys	Trp	Ile	Val	Lys	Ala	Ala	Pro	Ser
			20					25					30		
Cys	Ser	Glu	Lys	Lys	Gly	Asn	Tyr	Ala	Cys	Leu	Leu	Arg	Glu	Asp	Gln
		35					40					45			
Gly	Trp	Tyr	Cys	Gln	Asn	Ala	Gly	Ser	Thr	Val	Tyr	Tyr	Pro	Asn	Glu
	50					55					60				
Lys	Asp	Cys	Glu	Thr	Arg	Gly	Asp	His	Val	Phe	Cys	Asp	Thr	Ala	Ala
65					70					75					80
Gly	Ile	Asn	Val	Ala	Glu	Gln	Ser	Lys	Glu	Cys	Asn	Ile	Asn	Ile	Ser
				85					90					95	
Thr	Thr	Asn	Tyr	Pro	Cys	Lys	Val	Ser	Thr	Gly	Arg	His	Pro	Ile	Ser
			100					105					110		
Met	Val	Ala	Leu	Ser	Pro	Leu	Gly	Ala	Leu	Val	Ala	Cys	Tyr	Lys	Gly
		115					120					125			
Val	Ser	Cys	Ser	Ile	Gly	Ser	Asn	Arg	Val	Gly	Ile	Ile	Lys	Gln	Leu
	130					135					140				
Asn	Lys	Gly	Cys	Ser											
145															

<210> 269

<211> 149

<212> PRT

<213> human metapneumo virus

<400> 269

Ile	Gly	Val	Tyr	Gly	Ser	Ser	Val	Ile	Tyr	Met	Val	Gln	Leu	Pro	Ile
1				5					10					15	
Phe	Gly	Val	Ile	Asp	Thr	Pro	Cys	Trp	Ile	Val	Lys	Ala	Ala	Pro	Ser
			20					25					30		
Cys	Ser	Glu	Lys	Lys	Gly	Asn	Tyr	Ala	Cys	Leu	Leu	Arg	Glu	Asp	Gln
		35					40					45			
Gly	Trp	Tyr	Cys	Gln	Asn	Ala	Gly	Ser	Thr	Val	Tyr	Tyr	Pro	Asn	Glu
	50					55					60				
Lys	Asp	Cys	Glu	Thr	Arg	Gly	Asp	His	Val	Phe	Cys	Asp	Thr	Ala	Ala
65					70					75					80
Gly	Ile	Asn	Val	Ala	Glu	Gln	Ser	Lys	Glu	Cys	Asn	Ile	Asn	Ile	Ser
				85					90					95	
Thr	Thr	Asn	Tyr	Pro	Cys	Lys	Val	Ser	Thr	Gly	Arg	His	Pro	Ile	Ser
			100					105					110		

Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Asn Lys Gly Cys Ser
 145

<210> 270
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 270
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Asn Lys Gly Cys Ser
 145

<210> 271
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 271
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Asn Lys Gly Cys Ser

145

<210> 272
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 272
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Asn Lys Gly Cys Ser
 145

<210> 273
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 273
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Asn Lys Gly Cys Ser
 145

<210> 274
 <211> 149

<212> PRT

<213> human metapneumo virus

<400> 274

```

Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
      20           25           30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
      35           40           45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
      50           55           60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
      65           70           75           80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
      85           90           95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
      100          105          110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
      115          120          125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
      130          135          140
Asn Lys Gly Cys Ser
145

```

<210> 275

<211> 149

<212> PRT

<213> human metapneumo virus

<400> 275

```

Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
      20           25           30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
      35           40           45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
      50           55           60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
      65           70           75           80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
      85           90           95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
      100          105          110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
      115          120          125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
      130          135          140
Asn Lys Gly Cys Ser
145

```

<210> 276

<211> 149

<212> PRT

<213> human metapneumo virus

<400> 276

```

Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile

```

```

1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
20           25           30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
35           40           45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
50           55           60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65           70           75           80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
85           90           95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
100          105          110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
115          120          125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
130          135          140
Asn Lys Gly Cys Ser
145

```

<210> 277
 <211> 149
 <212> PRT
 <213> human metapneumo virus

```

<400> 277
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala Ala Pro Ser
20           25           30
Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
35           40           45
Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
50           55           60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65           70           75           80
Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile Asn Ile Ser
85           90           95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
100          105          110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
115          120          125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
130          135          140
Asn Lys Gly Cys Ser
145

```

<210> 278
 <211> 149
 <212> PRT
 <213> human metapneumo virus

```

<400> 278
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
20           25           30
Cys Ser Glu Lys Asn Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
35           40           45

```

Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Pro Lys Gly Cys Ser
 145

<210> 279

<211> 149

<212> PRT

<213> human metapneumo virus

<400> 279

Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Asn Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Trp Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Pro Lys Gly Cys Ser
 145

<210> 280

<211> 149

<212> PRT

<213> human metapneumo virus

<400> 280

Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Asn Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser

```

                85                90                95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
                100                105                110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
                115                120                125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
                130                135                140
Pro Lys Gly Cys Ser
145

```

<210> 281
 <211> 149
 <212> PRT
 <213> human metapneumo virus

```

<400> 281
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
1      5      10      15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
      20      25      30
Cys Ser Glu Lys Asn Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
      35      40      45
Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
      50      55      60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65      70      75      80
Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
      85      90      95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
      100     105     110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
      115     120     125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
      130     135     140
Pro Lys Gly Cys Ser
145

```

<210> 282
 <211> 149
 <212> PRT
 <213> human metapneumo virus

```

<400> 282
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
1      5      10      15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
      20      25      30
Cys Ser Glu Lys Asn Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
      35      40      45
Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
      50      55      60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65      70      75      80
Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
      85      90      95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
      100     105     110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
      115     120     125

```

Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Pro Lys Gly Cys Ser
 145

<210> 283
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 283
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Asn Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Pro Lys Gly Cys Ser
 145

<210> 284
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 284
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Asn Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Pro Lys Gly Cys Ser
 145

<210> 285
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 285
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Asn Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Ser Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Pro Lys Gly Cys Ser
 145

<210> 286
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 286
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Asn Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Pro Lys Gly Cys Ser
 145

<210> 287
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 287

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Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
          20           25           30
Cys Ser Glu Lys Asn Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
          35           40           45
Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
          50           55           60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65           70           75           80
Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
          85           90           95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
          100          105          110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
          115          120          125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
          130          135          140
Pro Lys Gly Cys Ser
145

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<210> 288

<211> 149

<212> PRT

<213> human metapneumo virus

<400> 288

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Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
          20           25           30
Cys Ser Glu Lys Asn Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
          35           40           45
Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
          50           55           60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65           70           75           80
Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
          85           90           95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
          100          105          110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
          115          120          125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
          130          135          140
Pro Lys Gly Cys Ser
145

```

<210> 289

<211> 149

<212> PRT

<213> human metapneumo virus

<400> 289

```

Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser

```

```

      20      25      30
Cys Ser Glu Lys Asn Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
      35      40      45
Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
      50      55      60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65      70      75      80
Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
      85      90      95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
      100      105      110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
      115      120      125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
      130      135      140
Pro Lys Gly Cys Ser
145

```

<210> 290
 <211> 149
 <212> PRT
 <213> human metapneumo virus

```

<400> 290
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
1      5      10      15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
      20      25      30
Cys Ser Glu Lys Asn Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
      35      40      45
Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
      50      55      60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65      70      75      80
Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
      85      90      95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
      100      105      110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
      115      120      125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
      130      135      140
Pro Lys Gly Cys Ser
145

```

<210> 291
 <211> 149
 <212> PRT
 <213> human metapneumo virus

```

<400> 291
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
1      5      10      15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
      20      25      30
Cys Ser Glu Lys Asn Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
      35      40      45
Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
      50      55      60

```


Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Pro Lys Gly Cys Ser
 145

<210> 292
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 292
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Asn Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Pro Lys Gly Cys Ser
 145

<210> 293
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 293
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Asn Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser

			100					105					110				
Met	Val	Ala	Leu	Ser	Pro	Leu	Gly	Ala	Leu	Val	Ala	Cys	Tyr	Lys	Gly		
		115					120					125					
Val	Ser	Cys	Ser	Ile	Gly	Ser	Asn	Arg	Val	Gly	Ile	Ile	Lys	Gln	Leu		
	130					135					140						
Pro	Lys	Gly	Cys	Ser													
145																	

<210> 294
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 294																	
Ile	Gly	Val	Tyr	Gly	Ser	Ser	Val	Ile	Tyr	Met	Val	Gln	Leu	Pro	Ile		
1				5					10					15			
Phe	Gly	Val	Ile	Asp	Thr	Pro	Cys	Trp	Ile	Ile	Lys	Ala	Ala	Pro	Ser		
		20						25					30				
Cys	Ser	Glu	Lys	Asn	Gly	Asn	Tyr	Ala	Cys	Leu	Leu	Arg	Glu	Asp	Gln		
	35					40						45					
Gly	Trp	Tyr	Cys	Lys	Asn	Ala	Gly	Ser	Thr	Val	Tyr	Tyr	Pro	Asn	Glu		
	50				55						60						
Lys	Asp	Cys	Glu	Thr	Arg	Gly	Asp	His	Val	Phe	Cys	Asp	Thr	Ala	Ala		
65				70					75						80		
Gly	Ile	Asn	Val	Ala	Glu	Gln	Ser	Arg	Glu	Cys	Asn	Ile	Asn	Ile	Ser		
		85						90					95				
Thr	Thr	Asn	Tyr	Pro	Cys	Lys	Val	Ser	Thr	Gly	Arg	His	Pro	Ile	Ser		
		100						105					110				
Met	Val	Ala	Leu	Ser	Pro	Leu	Gly	Ala	Leu	Val	Ala	Cys	Tyr	Lys	Gly		
	115						120					125					
Val	Ser	Cys	Ser	Ile	Gly	Ser	Asn	Arg	Val	Gly	Ile	Ile	Lys	Gln	Leu		
	130					135					140						
Pro	Lys	Gly	Cys	Ser													
145																	

<210> 295
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 295																	
Ile	Gly	Val	Tyr	Gly	Ser	Ser	Val	Ile	Tyr	Met	Val	Gln	Leu	Pro	Ile		
1				5					10					15			
Phe	Gly	Val	Ile	Asp	Thr	Pro	Cys	Trp	Ile	Ile	Lys	Ala	Ala	Pro	Ser		
		20						25					30				
Cys	Ser	Glu	Lys	Asn	Gly	Asn	Tyr	Ala	Cys	Leu	Leu	Arg	Glu	Asp	Gln		
	35					40						45					
Gly	Trp	Tyr	Cys	Lys	Asn	Ala	Gly	Ser	Thr	Val	Tyr	Tyr	Pro	Asn	Glu		
	50				55						60						
Lys	Asp	Cys	Glu	Thr	Arg	Gly	Asp	His	Val	Phe	Cys	Asp	Thr	Ala	Ala		
65				70					75						80		
Gly	Ile	Asn	Val	Ala	Glu	Gln	Ser	Arg	Glu	Cys	Asn	Ile	Asn	Ile	Ser		
		85						90					95				
Thr	Thr	Asn	Tyr	Pro	Cys	Lys	Val	Ser	Thr	Gly	Arg	His	Pro	Ile	Ser		
		100						105					110				
Met	Val	Ala	Leu	Ser	Pro	Leu	Gly	Ala	Leu	Val	Ala	Cys	Tyr	Lys	Gly		
	115						120					125					
Val	Ser	Cys	Ser	Ile	Gly	Ser	Asn	Arg	Val	Gly	Ile	Ile	Lys	Gln	Leu		
	130					135					140						

Pro Lys Gly Cys Ser
145

<210> 296
<211> 149
<212> PRT
<213> human metapneumo virus

<400> 296
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
1 5 10 15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
20 25 30
Cys Ser Glu Lys Asn Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
35 40 45
Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
50 55 60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65 70 75 80
Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
85 90 95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
100 105 110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
115 120 125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
130 135 140
Pro Lys Gly Cys Ser
145

<210> 297
<211> 149
<212> PRT
<213> human metapneumo virus

<400> 297
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
1 5 10 15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
20 25 30
Cys Ser Glu Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
35 40 45
Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
50 55 60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65 70 75 80
Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
85 90 95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
100 105 110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
115 120 125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
130 135 140
Pro Lys Gly Cys Ser
145

<210> 298

<211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 298
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Pro Lys Gly Cys Ser
 145

<210> 299
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 299
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Pro Lys Gly Cys Ser
 145

<210> 300
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 300

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Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1          5          10          15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
          20          25          30
Cys Ser Glu Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
          35          40          45
Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50          55          60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65          70          75          80
Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
          85          90          95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
          100          105          110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
          115          120          125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
          130          135          140
Pro Lys Gly Cys Ser
145

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```

<210> 301
<211> 149
<212> PRT
<213> human metapneumo virus

```

```

<400> 301
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1          5          10          15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
          20          25          30
Cys Ser Glu Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
          35          40          45
Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50          55          60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65          70          75          80
Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
          85          90          95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
          100          105          110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
          115          120          125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
          130          135          140
Pro Lys Gly Cys Ser
145

```

```

<210> 302
<211> 149
<212> PRT
<213> human metapneumo virus

```

```

<400> 302
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1          5          10          15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
          20          25          30
Cys Ser Glu Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln

```

```

      35              40              45
Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
      50              55              60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
      65              70              75              80
Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
      85              90              95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
      100              105              110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
      115              120              125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
      130              135              140
Pro Lys Gly Cys Ser
145

```

<210> 303
 <211> 149
 <212> PRT
 <213> human metapneumo virus

```

<400> 303
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
  1              5              10              15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
      20              25              30
Cys Ser Glu Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
      35              40              45
Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
      50              55              60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
      65              70              75              80
Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
      85              90              95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
      100              105              110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
      115              120              125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
      130              135              140
Pro Lys Gly Cys Ser
145

```

<210> 304
 <211> 149
 <212> PRT
 <213> human metapneumo virus

```

<400> 304
Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
  1              5              10              15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
      20              25              30
Cys Ser Glu Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
      35              40              45
Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
      50              55              60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
      65              70              75              80

```

Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Pro Lys Gly Cys Ser
 145

<210> 305

<211> 149

<212> PRT

<213> human metapneumo virus

<400> 305

Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Pro Lys Gly Cys Ser
 145

<210> 306

<211> 149

<212> PRT

<213> human metapneumo virus

<400> 306

Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly

	115		120		125
Val	Ser Cys Ser Ile Gly Ser	Asn Arg Val Gly Ile	Ile Lys Gln Leu		
	130	135	140		
Pro	Lys Gly Cys Ser				
145					

<210> 307
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 307
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Pro Lys Gly Cys Ser
 145

<210> 308
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 308
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Pro Lys Gly Cys Ser
 145

<210> 309
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 309
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Pro Lys Gly Cys Ser
 145

<210> 310
 <211> 149
 <212> PRT
 <213> human metapneumo virus

<400> 310
 Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1 5 10 15
 Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Pro Lys Gly Cys Ser
 145

<210> 311
 <211> 149
 <212> PRT

<213> human metapneumo virus

<400> 311

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Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
          20           25           30
Cys Ser Glu Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
          35           40           45
Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
          50           55           60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65           70           75           80
Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
          85           90           95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
          100          105          110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
          115          120          125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
          130          135          140
Pro Lys Gly Cys Ser
145

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<210> 312

<211> 149

<212> PRT

<213> human metapneumo virus

<400> 312

```

Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1           5           10           15
Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
          20           25           30
Cys Ser Glu Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
          35           40           45
Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
          50           55           60
Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
65           70           75           80
Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
          85           90           95
Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
          100          105          110
Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
          115          120          125
Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
          130          135          140
Pro Lys Gly Cys Ser
145

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<210> 313

<211> 149

<212> PRT

<213> human metapneumo virus

<400> 313

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Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln Leu Pro Ile
 1           5           10           15

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Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala Ala Pro Ser
 20 25 30
 Cys Ser Glu Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg Glu Asp Gln
 35 40 45
 Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr Pro Asn Glu
 50 55 60
 Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp Thr Ala Ala
 65 70 75 80
 Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile Asn Ile Ser
 85 90 95
 Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His Pro Ile Ser
 100 105 110
 Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys Tyr Lys Gly
 115 120 125
 Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile Lys Gln Leu
 130 135 140
 Pro Lys Gly Cys Ser
 145

<210> 314

<211> 539

<212> PRT

<213> human metapneumo virus

<400> 314

Met Ser Trp Lys Val Val Ile Ile Phe Ser Leu Leu Ile Thr Pro Gln
 1 5 10 15
 His Gly Leu Lys Glu Ser Tyr Leu Glu Glu Ser Cys Ser Thr Ile Thr
 20 25 30
 Glu Gly Tyr Leu Ser Val Leu Arg Thr Gly Trp Tyr Thr Asn Val Phe
 35 40 45
 Thr Leu Glu Val Gly Asp Val Glu Asn Leu Thr Cys Ala Asp Gly Pro
 50 55 60
 Ser Leu Ile Lys Thr Glu Leu Asp Leu Thr Lys Ser Ala Leu Arg Glu
 65 70 75 80
 Leu Arg Thr Val Ser Ala Asp Gln Leu Ala Arg Glu Glu Gln Ile Glu
 85 90 95
 Asn Pro Arg Gln Ser Arg Phe Val Leu Gly Ala Ile Ala Leu Gly Val
 100 105 110
 Ala Thr Ala Ala Ala Val Thr Ala Gly Val Ala Ile Ala Lys Thr Ile
 115 120 125
 Arg Leu Glu Ser Glu Val Thr Ala Ile Lys Asn Ala Leu Lys Lys Thr
 130 135 140
 Asn Glu Ala Val Ser Thr Leu Gly Asn Gly Val Arg Val Leu Ala Thr
 145 150 155 160
 Ala Val Arg Glu Leu Lys Asp Phe Val Ser Lys Asn Leu Thr Arg Ala
 165 170 175
 Ile Asn Lys Asn Lys Cys Asp Ile Ala Asp Leu Lys Met Ala Val Ser
 180 185 190
 Phe Ser Gln Phe Asn Arg Arg Phe Leu Asn Val Val Arg Gln Phe Ser
 195 200 205
 Asp Asn Ala Gly Ile Thr Pro Ala Ile Ser Leu Asp Leu Met Thr Asp
 210 215 220
 Ala Glu Leu Ala Arg Ala Val Ser Asn Met Pro Thr Ser Ala Gly Gln
 225 230 235 240
 Ile Lys Leu Met Leu Glu Asn Arg Ala Met Val Arg Arg Lys Gly Phe
 245 250 255
 Gly Ile Leu Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln
 260 265 270
 Leu Pro Ile Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala

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      275              280              285
Ala Pro Ser Cys Ser Gly Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg
      290              295              300
Glu Asp Gln Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr
305              310              315              320
Pro Asn Glu Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp
      325              330              335
Thr Ala Ala Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile
      340              345              350
Asn Ile Ser Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His
      355              360              365
Pro Ile Ser Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys
      370              375              380
Tyr Lys Gly Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile
385              390              395              400
Lys Gln Leu Asn Lys Gly Cys Ser Tyr Ile Thr Asn Gln Asp Ala Asp
      405              410              415
Thr Val Thr Ile Asp Asn Thr Val Tyr Gln Leu Ser Lys Val Glu Gly
      420              425              430
Glu Gln His Val Ile Lys Gly Arg Pro Val Ser Ser Ser Phe Asp Pro
      435              440              445
Val Lys Phe Pro Glu Asp Gln Phe Asn Val Ala Leu Asp Gln Val Phe
      450              455              460
Glu Ser Ile Glu Asn Ser Gln Ala Leu Val Asp Gln Ser Asn Arg Ile
465              470              475              480
Leu Ser Ser Ala Glu Lys Gly Asn Thr Gly Phe Ile Ile Val Ile Ile
      485              490              495
Leu Ile Ala Val Leu Gly Ser Thr Met Ile Leu Val Ser Val Phe Ile
      500              505              510
Ile Ile Lys Lys Thr Lys Lys Pro Thr Gly Ala Pro Pro Glu Leu Ser
      515              520              525
Gly Val Thr Asn Asn Gly Phe Ile Pro His Asn
      530              535

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<210> 315

<211> 539

<212> PRT

<213> human metapneumo virus

<400> 315

```

Met Ser Trp Lys Val Val Ile Ile Phe Ser Leu Leu Ile Thr Pro Gln
 1              5              10              15
His Gly Leu Lys Glu Ser Tyr Leu Glu Ser Cys Ser Thr Ile Thr
      20              25              30
Glu Gly Tyr Leu Ser Val Leu Arg Thr Gly Trp Tyr Thr Asn Val Phe
      35              40              45
Thr Leu Glu Val Gly Asp Val Glu Asn Leu Thr Cys Ser Asp Gly Pro
      50              55              60
Ser Leu Ile Lys Thr Glu Leu Asp Leu Thr Lys Ser Ala Leu Arg Glu
65              70              75              80
Leu Lys Thr Val Ser Ala Asp Gln Leu Ala Arg Glu Glu Gln Ile Glu
      85              90              95
Asn Pro Arg Gln Ser Arg Phe Val Leu Gly Ala Ile Ala Leu Gly Val
      100              105              110
Ala Thr Ala Ala Ala Val Thr Ala Gly Val Ala Ile Ala Lys Thr Ile
      115              120              125
Arg Leu Glu Ser Glu Val Thr Ala Ile Lys Asn Ala Leu Lys Thr Thr
      130              135              140
Asn Glu Ala Val Ser Thr Leu Gly Asn Gly Val Arg Val Leu Ala Thr
145              150              155              160

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Ala Val Arg Glu Leu Lys Asp Phe Val Ser Lys Asn Leu Thr Arg Ala
 165 170 175
 Ile Asn Lys Asn Lys Cys Asp Ile Asp Asp Leu Lys Met Ala Val Ser
 180 185 190
 Phe Ser Gln Phe Asn Arg Arg Phe Leu Asn Val Val Arg Gln Phe Ser
 195 200 205
 Asp Asn Ala Gly Ile Thr Pro Ala Ile Ser Leu Asp Leu Met Thr Asp
 210 215 220
 Ala Glu Leu Ala Arg Ala Val Ser Asn Met Pro Thr Ser Ala Gly Gln
 225 230 235 240
 Ile Lys Leu Met Leu Glu Asn Arg Ala Met Val Arg Arg Lys Gly Phe
 245 250 255
 Gly Ile Leu Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Thr Val Gln
 260 265 270
 Leu Pro Ile Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Val Lys Ala
 275 280 285
 Ala Pro Ser Cys Ser Glu Lys Lys Gly Asn Tyr Ala Cys Leu Leu Arg
 290 295 300
 Glu Asp Gln Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr
 305 310 315 320
 Pro Asn Glu Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp
 325 330 335
 Thr Ala Ala Gly Ile Asn Val Ala Glu Gln Ser Lys Glu Cys Asn Ile
 340 345 350
 Asn Ile Ser Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His
 355 360 365
 Pro Ile Ser Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys
 370 375 380
 Tyr Lys Gly Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile
 385 390 395 400
 Lys Gln Leu Asn Lys Gly Cys Ser Tyr Ile Thr Asn Gln Asp Ala Asp
 405 410 415
 Thr Val Thr Ile Asp Asn Thr Val Tyr Gln Leu Ser Lys Val Glu Gly
 420 425 430
 Glu Gln His Val Ile Lys Gly Arg Pro Val Ser Ser Ser Phe Asp Pro
 435 440 445
 Ile Lys Phe Pro Glu Asp Gln Phe Asn Val Ala Leu Asp Gln Val Phe
 450 455 460
 Glu Asn Ile Glu Asn Ser Gln Ala Leu Val Asp Gln Ser Asn Arg Ile
 465 470 475 480
 Leu Ser Ser Ala Glu Lys Gly Asn Thr Gly Phe Ile Ile Val Ile Ile
 485 490 495
 Leu Ile Ala Val Leu Gly Ser Ser Met Ile Leu Val Ser Ile Phe Ile
 500 505 510
 Ile Ile Lys Lys Thr Lys Lys Pro Thr Gly Ala Pro Pro Glu Leu Ser
 515 520 525
 Gly Val Thr Asn Asn Gly Phe Ile Pro His Ser
 530 535

<210> 316

<211> 539

<212> PRT

<213> human metapneumo virus

<400> 316

Met Ser Trp Lys Val Met Ile Ile Ile Ser Leu Leu Ile Thr Pro Gln
 1 5 10 15
 His Gly Leu Lys Glu Ser Tyr Leu Glu Glu Ser Cys Ser Thr Ile Thr
 20 25 30
 Glu Gly Tyr Leu Ser Val Leu Arg Thr Gly Trp Tyr Thr Asn Val Phe

35	40	45
Thr Leu Glu Val Gly Asp	Val Glu Asn Leu Thr	Cys Thr Asp Gly Pro
50	55	60
Ser Leu Ile Lys Thr Glu	Leu Asp Leu Thr Lys	Ser Ala Leu Arg Glu
65	70	75
Leu Lys Thr Val Ser Ala	Asp Gln Leu Ala Arg	Glu Glu Gln Ile Glu
85	90	95
Asn Pro Arg Gln Ser Arg	Phe Val Leu Gly Ala	Ile Ala Leu Gly Val
100	105	110
Ala Thr Ala Ala Val Thr	Ala Gly Ile Ala Ile	Ala Lys Thr Ile
115	120	125
Arg Leu Glu Ser Glu Val	Asn Ala Ile Lys Gly	Ala Leu Lys Gln Thr
130	135	140
Asn Glu Ala Val Ser Thr	Leu Gly Asn Gly Val	Arg Val Leu Ala Thr
145	150	155
Ala Val Arg Glu Leu Lys	Glu Phe Val Ser Lys	Asn Leu Thr Ser Ala
165	170	175
Ile Asn Arg Asn Lys Cys	Asp Ile Ala Asp Leu	Lys Met Ala Val Ser
180	185	190
Phe Ser Gln Phe Asn Arg	Arg Phe Leu Asn Val	Val Arg Gln Phe Ser
195	200	205
Asp Asn Ala Gly Ile Thr	Pro Ala Ile Ser Leu	Asp Leu Met Thr Asp
210	215	220
Ala Glu Leu Ala Arg Ala	Val Ser Tyr Met Pro	Thr Ser Ala Gly Gln
225	230	235
Ile Lys Leu Met Leu Glu	Asn Arg Ala Met Val	Arg Arg Lys Gly Phe
245	250	255
Gly Ile Leu Ile Gly Val	Tyr Gly Ser Ser Val	Ile Tyr Met Val Gln
260	265	270
Leu Pro Ile Phe Gly Val	Ile Asp Thr Pro Cys	Trp Ile Ile Lys Ala
275	280	285
Ala Pro Ser Cys Ser Glu	Lys Asn Gly Asn Tyr	Ala Cys Leu Leu Arg
290	295	300
Glu Asp Gln Gly Trp Tyr	Cys Lys Asn Ala Gly	Ser Thr Val Tyr Tyr
305	310	315
Pro Asn Glu Lys Asp Cys	Glu Thr Arg Gly Asp	His Val Phe Cys Asp
325	330	335
Thr Ala Ala Gly Ile Asn	Val Ala Glu Gln Ser	Arg Glu Cys Asn Ile
340	345	350
Asn Ile Ser Thr Thr Asn	Tyr Pro Cys Lys Val	Ser Thr Gly Arg His
355	360	365
Pro Ile Ser Met Val Ala	Leu Ser Pro Leu Gly	Ala Leu Val Ala Cys
370	375	380
Tyr Lys Gly Val Ser Cys	Ser Ile Gly Ser Asn	Trp Val Gly Ile Ile
385	390	395
Lys Gln Leu Pro Lys Gly	Cys Ser Tyr Ile Thr	Asn Gln Asp Ala Asp
405	410	415
Thr Val Thr Ile Asp Asn	Thr Val Tyr Gln Leu	Ser Lys Val Glu Gly
420	425	430
Glu Gln His Val Ile Lys	Gly Arg Pro Val Ser	Ser Ser Phe Asp Pro
435	440	445
Ile Lys Phe Pro Glu Asp	Gln Phe Asn Val Ala	Leu Asp Gln Val Phe
450	455	460
Glu Ser Ile Glu Asn Ser	Gln Ala Leu Val Asp	Gln Ser Asn Lys Ile
465	470	475
Leu Asn Ser Ala Glu Lys	Gly Asn Thr Gly Phe	Ile Ile Val Val Ile
485	490	495
Leu Val Ala Val Leu Gly	Leu Thr Met Ile Ser	Val Ser Ile Ile Ile
500	505	510
Ile Ile Lys Lys Thr Arg	Lys Pro Thr Gly Ala	Pro Pro Glu Leu Asn
515	520	525

Gly Val Thr Asn Gly Gly Phe Ile Pro His Ser
530 535

<210> 317

<211> 539

<212> PRT

<213> human metapneumo virus

<400> 317

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Met Ser Trp Lys Val Met Ile Ile Ile Ser Leu Leu Ile Thr Pro Gln
 1           5           10           15
His Gly Leu Lys Glu Ser Tyr Leu Glu Glu Ser Cys Ser Thr Ile Thr
      20           25           30
Glu Gly Tyr Leu Ser Val Leu Arg Thr Gly Trp Tyr Thr Asn Val Phe
      35           40           45
Thr Leu Glu Val Gly Asp Val Glu Asn Leu Thr Cys Thr Asp Gly Pro
      50           55           60
Ser Leu Ile Lys Thr Glu Leu Asp Leu Thr Lys Ser Ala Leu Arg Glu
      65           70           75           80
Leu Lys Thr Val Ser Ala Asp Gln Leu Ala Arg Glu Glu Gln Ile Glu
      85           90           95
Asn Pro Arg Gln Ser Arg Phe Val Leu Gly Ala Ile Ala Leu Gly Val
      100          105          110
Ala Thr Ala Ala Ala Val Thr Ala Gly Ile Ala Ile Ala Lys Thr Ile
      115          120          125
Arg Leu Glu Ser Glu Val Asn Ala Ile Lys Gly Ala Leu Lys Thr Thr
      130          135          140
Asn Glu Ala Val Ser Thr Leu Gly Asn Gly Val Arg Val Leu Ala Thr
      145          150          155          160
Ala Val Arg Glu Leu Lys Glu Phe Val Ser Lys Asn Leu Thr Ser Ala
      165          170          175
Ile Asn Lys Asn Lys Cys Asp Ile Ala Asp Leu Lys Met Ala Val Ser
      180          185          190
Phe Ser Gln Phe Asn Arg Arg Phe Leu Asn Val Val Arg Gln Phe Ser
      195          200          205
Asp Asn Ala Gly Ile Thr Pro Ala Ile Ser Leu Asp Leu Met Thr Asp
      210          215          220
Ala Glu Leu Ala Arg Ala Val Ser Tyr Met Pro Thr Ser Ala Gly Gln
      225          230          235          240
Ile Lys Leu Met Leu Glu Asn Arg Ala Met Val Arg Arg Lys Gly Phe
      245          250          255
Gly Ile Leu Ile Gly Val Tyr Gly Ser Ser Val Ile Tyr Met Val Gln
      260          265          270
Leu Pro Ile Phe Gly Val Ile Asp Thr Pro Cys Trp Ile Ile Lys Ala
      275          280          285
Ala Pro Ser Cys Ser Glu Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg
      290          295          300
Glu Asp Gln Gly Trp Tyr Cys Lys Asn Ala Gly Ser Thr Val Tyr Tyr
      305          310          315          320
Pro Asn Glu Lys Asp Cys Glu Thr Arg Gly Asp His Val Phe Cys Asp
      325          330          335
Thr Ala Ala Gly Ile Asn Val Ala Glu Gln Ser Arg Glu Cys Asn Ile
      340          345          350
Asn Ile Ser Thr Thr Asn Tyr Pro Cys Lys Val Ser Thr Gly Arg His
      355          360          365
Pro Ile Ser Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys
      370          375          380
Tyr Lys Gly Val Ser Cys Ser Ile Gly Ser Asn Arg Val Gly Ile Ile
      385          390          395          400
Lys Gln Leu Pro Lys Gly Cys Ser Tyr Ile Thr Asn Gln Asp Ala Asp

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gagagctacc tagaagaatc atgtagcact ataactgagg gatatccttag tgttctgagg 120
acagggttgg ataccaacgt ttttacatta gaggtgggtg atgtagaaaa ccttacatgt 180
tctgatggac ctagcctaata aaaaacagaa ttagatctga ccaaaagtgc actaagagag 240
ctcaaaacag tctctgctga ccaattggca agagaggaac aaattgagaa tcccagacaa 300
tctagggttg ttctaggagc aatagcactc ggtgttgcaa cagcagctgc agtcacagca 360
ggtgttgcaa ttgccaaaac catccggctt gagagtgaag tcacagcaat taagaatgcc 420
ctcaaaacga ccaatgaagc agtatctaca ttgggggaatg gagttcgagt gttggcaact 480
gcagtggagag agctaaaaga ctttgtgagc aagaatttaa ctctgtgcaat caacaaaaac 540
aagtggcgaca ttgatgacct aaaaatggct gttagcttca gtcaattcaa cagaagggtt 600
ctaaatggtg tgcggcaatt ttccagacaat gctggaataa caccagcaat atctttggac 660
ttaatgacag atgtgaact agccagggcc gtttctaaca tgccgacatc tgcaggacaa 720
ataaaattga tgttgagaa ccgtgcgatg gtgcgaagaa aggggttcgg aatcctgata 780
ggggtctacg ggagctccgt aatttacacg gtgcagctgc caatctttgg cgttatagac 840
acgccttgct ggatagtaaa agcagccctt tcttgttccg aaaaaaaggg aaactatgct 900
tgctcttaa gagaagacca aggggtggtat tgtcagaatg cagggtcaac tgtttactac 960
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aagcagctga acaaaggctt ctcctatata accaaccaag atgcagacac agtgacaata 1260
gacaacactg tatatcagct aagcaaagtt gaggggtgaac agcatgttat aaaaggcaga 1320
ccagtgtcaa gcagctttga tccaatcaag tttcctgaag atcaattcaa tgttgcactt 1380
gaccaagttt ttgagaacat tgaaaacagc caggccttag tagatcaatc aaacagaatc 1440
ctaagcagtg cagagaaagg gaatactggc tttatcattg taataattct aattgctgtc 1500
cttggctcta gcatgatcct agtgagcatc ttcattataa tcaagaaaac aaagaaacca 1560
acgggagcac ctccagagct gagtgggtgc acaaacaatg gtttcatacc acacagttag 1620

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<210> 320

<211> 1620

<212> DNA

<213> human metapneumo virus

<400> 320

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atgtcttggg aagtgatgat catcatttctg ttactcataa caccacagca cgggctaaag 60
gagagttatt tggaagaatc atgtagtact ataactgagg gatacctcag tgttttaaga 120
acaggctggg acactaatgt cttcacatta gaagttgggt atgttgaaaa tcttacatgt 180
actgatggac ctatgcttaat caaaacagaa cttgatctaa caaaaagtgc ttttaaggga 240
ctcaaaacag tctctgctga tcagttggcg agagaggagc aaattgaaaa tcccagacaa 300
tcaagatttg tcttaggtgc gatagctctc ggagttgcta cagcagcagc agtcacagca 360
ggcattgcaa tagccaaaac cataaggctt gagagtgagg tgaatgcaat taaagggtgct 420
ctcaaaacaa ctaatgaagc agtatccaca ttaggggaatg gtgtgctggg cctagccact 480
gcagtggagag agctaaaaga atttgtgagc aaaaacctga ctagtgcaat caacaggaac 540
aaatgtgaca ttgctgatct gaagatggct gtcagcttca gtcaattcaa cagaagattt 600
ctaaatggtg tgcggcagtt ttccagacaat gcagggataa caccagcaat atcattggac 660
ctgatgactg atgctgagtt ggccagagct gtatcatata tgccaacatc tgcaggggag 720
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ccaaatgaaa aagactgcga aacaagaggt gatcatgttt tttgtgacac agcagcaggg 1020
atcaatggtg ctgagcaatc aagagaatgc aacatcaaca tatctactac caactaccca 1080
tgcaaagtca gcacaggaag acaccctata agcatggttg cactatcacc tctcggtgct 1140
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aaacaattac ccaaaggctg ctcatacata accaaccagg atgcagacac tgtaacaatt 1260
gacaataacc tgtatcaact aagcaaagtt gaagggtgaac agcatgtaat aaaaggggaga 1320
ccagtttcaa gcagttttga tccaatcaag tttcctgagg atcagttcaa tgttgcgctt 1380
gatcaagtct tcgaaagcat tgagaacagt caggcactag tggaccagtc aaacaaaatt 1440
ctaaacagtg cagaaaaagg aaactactgg ttcattatcg tagtaatttt ggttgctgtt 1500
cttgggtctaa ccatgatctt agtgagcatc atcatcataa tcaagaaaac aaggaagccc 1560
acaggagcac ctccagagct gaatgggtgc accaacggcg gtttcatacc acatagttag 1620

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<210> 321
 <211> 1620
 <212> DNA
 <213> human metapneumo virus

<400> 321
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 acaggttggt acaccaatgt ctttacatta gaagttggtg atgttgaaaa tcttacatgt 180
 actgatggac ctagcttaat caaaacagaa cttgacctaa ccaaaagtgc tctgagagaa 240
 ctcaaaacag tttctgctga tcagtttagcg agagaagaac aaattgaaaa tcccagacaa 300
 tcaaggtttg tcctaggtgc aatagctctt ggagttgcca cagcagcagc agtcacagca 360
 ggcatgcaa tagccaaaac cataagactt gagagtgaag tgaatgcaat caaagggtgct 420
 ctcaaaacaa ccaacgagggc agtatccaca ctaggaaatg gagtgcgagt cctagccact 480
 gcagtaagag agctgaaaga atttgtgagc aaaaacctga ctagtgcgat caacaagaac 540
 aaatgtgaca ttgctgatct gaagatggct gtcagcttca gtcaattcaa cagaagattc 600
 ctaaagtgtg tgcggcagtt ttcagacaat gcagggataa caccagcaat atcattggac 660
 ctaatgactg atgctgagct ggccagagct gtatcataca tgccaacatc tgcaggacag 720
 ataaaaactaa tgttagagaa ccgtgcaatg gtgaggagaa aaggatttgg aatcttgata 780
 ggggtctacg gaagctctgt gattttacatg gtccagctgc cgatcttttg tgtcatagat 840
 acaccttggt ggataatcaa ggcagctccc tcttgttcag aaaaagatgg aaattatgct 900
 tgcctcctaa gagaggatca aggggtggtat tgcaaaaatg caggatccac tgtttactac 960
 ccaaatgaaa aagactgcca aacaagaggt gatcatgttt tttgtgacac agcagcaggg 1020
 atcaatgttg ctgagcaatc aagagaatgc aacatcaaca tatctaccac caactaccac 1080
 tgcaaagtca gcacaggaag acaccctatc agcatgggtg cactatcacc tctcgggtgct 1140
 ttggtagctt gctacaaggg gggttagctgc tgcattggca gtaatcgggt tgggaataatc 1200
 aaacaactac taaaggctg ctcatataca actaaccagg acgcagacac tgtaacaatt 1260
 gacaacactg tgtatcaact aagcaaagtt gaggggtgaac agcatgtaat aaaagggaga 1320
 ccagtttcaa gcagttttga tccaatcagg tttcctgagg atcagttcaa tgttgcgctt 1380
 gatcaagtct ttgaaagcat tgaaaacagt caagcactag tggaccagtc aaacaaaatt 1440
 ctgaacagtg cagaaaaagg aaacactggt ttcattattg taataatttt gatttgctgtt 1500
 cttgggttaa ccatgatctt agtgagcatc atcatcataa tcaaaaaaac aaggaagccc 1560
 acaggggacac ctccagagct gaatggtggt accaacggcg gttttataacc gcatagttag 1620

<210> 322
 <211> 236
 <212> PRT
 <213> human metapneumo virus

<400> 322
 Met Glu Val Lys Val Glu Asn Ile Arg Thr Ile Asp Met Leu Lys Ala
 1 5 10 15
 Arg Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
 20 25 30
 Leu Val Leu Ile Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
 35 40 45
 Leu Ile Ile Asn Tyr Lys Met Gln Lys Asn Thr Ser Glu Ser Glu His
 50 55 60
 His Thr Ser Ser Ser Pro Met Glu Ser Ser Arg Glu Thr Pro Thr Val
 65 70 75 80
 Pro Thr Asp Asn Ser Asp Thr Asn Ser Ser Pro Gln His Pro Thr Gln
 85 90 95
 Gln Ser Thr Glu Gly Ser Thr Leu Tyr Phe Ala Ala Ser Ala Ser Ser
 100 105 110
 Pro Glu Thr Glu Pro Thr Ser Thr Pro Asp Thr Thr Asn Arg Pro Pro
 115 120 125
 Phe Val Asp Thr His Thr Thr Pro Pro Ser Ala Ser Arg Thr Lys Thr
 130 135 140

Ser Pro Ala Val His Thr Lys Asn Asn Pro Arg Thr Ser Ser Arg Thr
 145 150 155 160
 His Ser Pro Pro Arg Ala Thr Thr Arg Thr Ala Arg Arg Thr Thr Thr
 165 170 175
 Leu Arg Thr Ser Ser Thr Arg Lys Arg Pro Ser Thr Ala Ser Val Gln
 180 185 190
 Pro Asp Ile Ser Ala Thr Thr His Lys Asn Glu Glu Ala Ser Pro Ala
 195 200 205
 Ser Pro Gln Thr Ser Ala Ser Thr Thr Arg Ile Gln Arg Lys Ser Val
 210 215 220
 Glu Ala Asn Thr Ser Thr Tyr Asn Gln Thr Ser
 225 230 235

<210> 323
 <211> 219
 <212> PRT
 <213> human metapneumo virus

<400> 323
 Met Glu Val Lys Val Glu Asn Ile Arg Ala Ile Asp Met Leu Lys Ala
 1 5 10 15
 Arg Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
 20 25 30
 Leu Ile Leu Ile Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
 35 40 45
 Leu Ile Ile Asn Tyr Thr Ile Gln Lys Thr Thr Ser Glu Ser Glu His
 50 55 60
 His Thr Ser Ser Pro Pro Thr Glu Pro Asn Lys Glu Ala Ser Thr Ile
 65 70 75 80
 Ser Thr Asp Asn Pro Asp Ile Asn Pro Ser Ser Gln His Pro Thr Gln
 85 90 95
 Gln Ser Thr Glu Asn Pro Thr Leu Asn Pro Ala Ala Ser Ala Ser Pro
 100 105 110
 Ser Glu Thr Glu Pro Ala Ser Thr Pro Asp Thr Thr Asn Arg Leu Ser
 115 120 125
 Ser Val Asp Arg Ser Thr Ala Gln Pro Ser Glu Ser Arg Thr Lys Thr
 130 135 140
 Lys Pro Thr Val His Thr Ile Asn Asn Pro Asn Thr Ala Ser Ser Thr
 145 150 155 160
 Gln Ser Pro Pro Arg Thr Thr Thr Lys Ala Ile Arg Arg Ala Thr Thr
 165 170 175
 Phe Arg Met Ser Ser Thr Gly Lys Arg Pro Thr Thr Thr Leu Val Gln
 180 185 190
 Ser Asp Ser Ser Thr Thr Thr Gln Asn His Glu Glu Thr Gly Ser Ala
 195 200 205
 Asn Pro Gln Ala Ser Ala Ser Thr Met Gln Asn
 210 215

<210> 324
 <211> 224
 <212> PRT
 <213> human metapneumo virus

<400> 324
 Met Glu Val Arg Val Glu Asn Ile Arg Ala Ile Asp Met Phe Lys Ala
 1 5 10 15
 Lys Ile Lys Asn Arg Ile Arg Ser Ser Arg Cys Tyr Arg Asn Ala Thr
 20 25 30
 Leu Ile Leu Ile Gly Leu Thr Ala Leu Ser Met Ala Leu Asn Ile Phe

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      35              40              45
Leu Ile Ile Asp His Ala Thr Leu Arg Asn Met Ile Lys Thr Glu Asn
  50              55              60
Cys Ala Asn Met Pro Ser Ala Glu Pro Ser Lys Lys Thr Pro Met Thr
  65              70              75              80
Ser Thr Ala Gly Pro Asn Thr Lys Pro Asn Pro Gln Gln Ala Thr Gln
      85              90              95
Trp Thr Thr Glu Asn Ser Thr Ser Pro Val Ala Thr Pro Glu Gly His
      100              105              110
Pro Tyr Thr Gly Thr Thr Gln Thr Ser Asp Thr Thr Ala Pro Gln Gln
      115              120              125
Thr Thr Asp Lys His Thr Ala Pro Leu Lys Ser Thr Asn Glu Gln Ile
      130              135              140
Thr Gln Thr Thr Thr Glu Lys Lys Thr Ile Arg Ala Thr Thr Gln Lys
  145              150              155              160
Arg Glu Lys Gly Lys Glu Asn Thr Asn Gln Thr Thr Ser Thr Ala Ala
      165              170              175
Thr Gln Thr Thr Asn Thr Thr Asn Gln Ile Arg Asn Ala Ser Glu Thr
      180              185              190
Ile Thr Thr Ser Asp Arg Pro Arg Thr Asp Thr Thr Thr Gln Ser Ser
      195              200              205
Glu Gln Thr Thr Arg Ala Thr Asp Pro Ser Ser Pro Pro His His Ala
      210              215              220

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<210> 325

<211> 236

<212> PRT

<213> human metapneumo virus

<400> 325

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Met Glu Val Arg Val Glu Asn Ile Arg Ala Ile Asp Met Phe Lys Ala
  1              5              10              15
Lys Met Lys Asn Arg Ile Arg Ser Ser Lys Cys Tyr Arg Asn Ala Thr
      20              25              30
Leu Ile Leu Ile Gly Leu Thr Ala Leu Ser Met Ala Leu Asn Ile Phe
      35              40              45
Leu Ile Ile Asp Tyr Ala Met Leu Lys Asn Met Thr Lys Val Glu His
      50              55              60
Cys Val Asn Met Pro Pro Val Glu Pro Ser Lys Lys Thr Pro Met Thr
  65              70              75              80
Ser Ala Val Asp Leu Asn Thr Lys Pro Asn Pro Gln Gln Ala Thr Gln
      85              90              95
Leu Ala Ala Glu Asp Ser Thr Ser Leu Ala Ala Thr Ser Glu Asp His
      100              105              110
Leu His Thr Gly Thr Thr Pro Thr Pro Asp Ala Thr Val Ser Gln Gln
      115              120              125
Thr Thr Asp Glu Tyr Thr Thr Leu Leu Arg Ser Thr Asn Arg Gln Thr
      130              135              140
Thr Gln Thr Thr Thr Glu Lys Lys Pro Thr Gly Ala Thr Thr Lys Lys
  145              150              155              160
Glu Thr Thr Thr Arg Thr Thr Ser Thr Ala Ala Thr Gln Thr Leu Asn
      165              170              175
Thr Thr Asn Gln Thr Ser Tyr Val Arg Glu Ala Thr Thr Thr Ser Ala
      180              185              190
Arg Ser Arg Asn Ser Ala Thr Thr Gln Ser Ser Asp Gln Thr Thr Gln
      195              200              205
Ala Ala Asp Pro Ser Ser Gln Pro His His Thr Gln Lys Ser Thr Thr
      210              215              220
Thr Thr Tyr Asn Thr Asp Thr Ser Ser Pro Ser Ser
  225              230              235

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<210> 326
 <211> 708
 <212> DNA
 <213> human metapneumo virus

<400> 326
 gaggtgaaag tggagaacat tgaacaata gatatgctca aagcaagagt aaaaaatcgt 60
 gtggcacgca gcaaagtgtt taaaaatgcc tctttggtcc tcataggaat aactacattg 120
 agtattgccc tcaatatcta tctgatcata aactataaaa tgcaaaaaaa cacatctgaa 180
 tcagaacatc acaccagctc atcaccatg gaatccagca gagaaactcc aacgggtcccc 240
 acagacaact cagacaccaa ctcaagccca cagcatccaa ctcaacagtc cacagaaggc 300
 tccacactct actttgcagc ctcaagcagc tcaccagaga cagaaccaac atcaacacca 360
 gatacaacaa accgcccgcg cttcgtcgac acacacacaa caccaccaag cgcaagcaga 420
 acaaagacaa gtccggcagt ccacacaaaa aacaacccaa ggacaagctc tagaacacat 480
 tctccaccac gggcaacgac aaggacggca cgcagaacca ccactctccg cacaagcagc 540
 acaagaaaga gaccgtccac agcatcagtc caacctgaca tcagcgcgaac aaccacacaa 600
 aacgaagaag caagtccagc gagcccacaa acatctgcaa gcacaacaag aatacaaaag 660
 aaaagcgtgg aggccaacac atcaacaaca tacaacccaa ctagttaa 708

<210> 327
 <211> 660
 <212> DNA
 <213> human metapneumo virus

<400> 327
 atggaggtga aagtagagaa cattcgagca atagacatgc tcaaagcaag agtgaaaaat 60
 cgtgtggcac gtagcaaatg ctttaaaaaat gtttctttaa tcctcatagg aataactaca 120
 ctgagtatag ctctcaatat ctatctgatc ataaactaca caatacaaaa aaccacatcc 180
 gaatcagaac accacaccag ctccaccacc acagaaccca acaaggaagc ttcaacaatc 240
 tccacagaca acccagacat caatccaagc tcacagcatc caactcaaca gtccacagaa 300
 aaccccacac tcaaccccgcc agcatcagcg agcccatcag aaacagaacc agcatcaaca 360
 ccagacacaa caaacccgct gtcctccgta gacagggtcca cagcacaacc aagtgaagc 420
 agaacaaaga caaaaccgac agtccacaca atcaacaacc caaacacagc ttccagtaca 480
 caatccccac caccggacaac aacgaaggca atccgcagag ccaccacttt ccgcatgagc 540
 agcacaggaa aaagaccaac cacaacatta gtccagtcgg acagcagcac cacaacccaa 600
 aatcatgaag aaacagggtc agcgaaccca caggcgtctg caagcacaat gcaaaaactag 660

<210> 328
 <211> 675
 <212> DNA
 <213> human metapneumo virus

<400> 328
 atggaagtaa gaggggagaa cattcgagcg atagacatgt tcaaagcaaa gataaaaaaac 60
 cgtataagaa gcagcagggtg ctatagaaat gctacactga tccttattgg actaacagcg 120
 ttaagcatgg cacttaatat tttcctgatc atcgatcatg caacattaag aaacatgatc 180
 aaaacagaaa actgtgctaa catgccgtcg gcagaaccaa gcaaaaagac cccaatgacc 240
 tccacagcag gcccaaacac caaacccaat ccacagcaag caacacagtg gaccacagag 300
 aactcaacat ccccgtagtc aaccccgagag ggccatccat acacaggggac aactcaaaaca 360
 tcagacacaa cagctcccca gcaaaccaca gacaaacaca cagcaccgct aaaatcaacc 420
 aatgaacaga tcacccagac aaccacagag aaaaagacaa tcagagcaac aacccaaaaa 480
 agggaaaaag gaaaagaaaa cacaaccaa accacaagca cagctgcaac ccaaacaacc 540
 aacaccacca accaaatcag aaatgcaagt gagacaatca caacatccga cagaccaga 600
 actgacacca caacccaaag cagcgaacag acaaccggg caacagaccc aagctcccca 660
 ccacaccatg catag 675

<210> 329
 <211> 711

<212> DNA

<213> human metapneumo virus

<400> 329

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atggaagtaa gagtggagaa cattcgggca atagacatgt tcaaagcaaa aatgaaaaac 60
cgtataagaa gtagcaagtg ctatagaaat gctacactga tccttattgg attaacagca 120
ttaagtatgg cacttaatat ttttttaatc attgattatg caatgttaaa aaacatgacc 180
aaagtggAAC actgtgttaa tatgccgccg gtagaaccAA gcaagaagac cccaatgacc 240
tctgcagtag acttaaacac caaacccaat ccacagcagg caacacagtt ggccgcagag 300
gattcaacat ctctagcagc aacctcagag gaccatctac acacagggac aactccaaca 360
ccagatgcaa cagtctctca gcaaaccaca gacgagtaca caacattgct gagatcaacc 420
aacagacaga ccacccaaac aaccacagag aaaaagccaa ccgagacaac aaccaaaaaa 480
gaaaccacaa ctcgaactac aagcacagct gcaacccaaa cactcaacac taccaaccaa 540
actagctatg tgagagaggg aaccacaaca tccgccagat ccagaaacag tgccacaact 600
caaagcagcg accaaacaac ccaggcagca gacccaagct cccaaccaca ccatacacag 660
aaaagcacia caacaacata caacacagac acatcctctc caagtagtta a 711

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<210> 330

<211> 2005

<212> PRT

<213> human metapneumo virus

<400> 330

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Met Asp Pro Leu Asn Glu Ser Thr Val Asn Val Tyr Leu Pro Asp Ser
1           5           10           15
Tyr Leu Lys Gly Val Ile Ser Phe Ser Glu Thr Asn Ala Ile Gly Ser
20           25           30
Cys Leu Leu Lys Arg Pro Tyr Leu Lys Asn Asp Asn Thr Ala Lys Val
35           40           45
Ala Ile Glu Asn Pro Val Ile Glu His Val Arg Leu Lys Asn Ala Val
50           55           60
Asn Ser Lys Met Lys Ile Ser Asp Tyr Lys Ile Val Glu Pro Val Asn
65           70           75           80
Met Gln His Glu Ile Met Lys Asn Val His Ser Cys Glu Leu Thr Leu
85           90           95
Leu Lys Gln Phe Leu Thr Arg Ser Lys Asn Ile Ser Thr Leu Lys Leu
100          105          110
Asn Met Ile Cys Asp Trp Leu Gln Leu Lys Ser Thr Ser Asp Asp Thr
115          120          125
Ser Ile Leu Ser Phe Ile Asp Val Glu Phe Ile Pro Ser Trp Val Ser
130          135          140
Asn Trp Phe Ser Asn Trp Tyr Asn Leu Asn Lys Leu Ile Leu Glu Phe
145          150          155          160
Arg Lys Glu Glu Val Ile Arg Thr Gly Ser Ile Leu Cys Arg Ser Leu
165          170          175
Gly Lys Leu Val Phe Val Val Ser Ser Tyr Gly Cys Ile Val Lys Ser
180          185          190
Asn Lys Ser Lys Arg Val Ser Phe Phe Thr Tyr Asn Gln Leu Leu Thr
195          200          205
Trp Lys Asp Val Met Leu Ser Arg Phe Asn Ala Asn Phe Cys Ile Trp
210          215          220
Val Ser Asn Ser Leu Asn Glu Asn Gln Glu Gly Leu Gly Leu Arg Ser
225          230          235          240
Asn Leu Gln Gly Ile Leu Thr Asn Lys Leu Tyr Glu Thr Val Asp Tyr
245          250          255
Met Leu Ser Leu Cys Cys Asn Glu Gly Phe Ser Leu Val Lys Glu Phe
260          265          270
Glu Gly Phe Ile Met Ser Glu Ile Leu Arg Ile Thr Glu His Ala Gln
275          280          285
Phe Ser Thr Arg Phe Arg Asn Thr Leu Leu Asn Gly Leu Thr Asp Gln
290          295          300

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Leu	Thr	Lys	Leu	Lys	Asn	Lys	Asn	Arg	Leu	Arg	Val	His	Gly	Thr	Val
305					310					315					320
Leu	Glu	Asn	Asn	Asp	Tyr	Pro	Met	Tyr	Glu	Val	Val	Leu	Lys	Leu	Leu
				325					330						335
Gly	Asp	Thr	Leu	Arg	Cys	Ile	Lys	Leu	Leu	Ile	Asn	Lys	Asn	Leu	Glu
			340					345					350		
Asn	Ala	Ala	Glu	Leu	Tyr	Tyr	Ile	Phe	Arg	Ile	Phe	Gly	His	Pro	Met
		355					360					365			
Val	Asp	Glu	Arg	Asp	Ala	Met	Asp	Ala	Val	Lys	Leu	Asn	Asn	Glu	Ile
	370					375					380				
Thr	Lys	Ile	Leu	Arg	Trp	Glu	Ser	Leu	Thr	Glu	Leu	Arg	Gly	Ala	Phe
385					390					395					400
Ile	Leu	Arg	Ile	Ile	Lys	Gly	Phe	Val	Asp	Asn	Asn	Lys	Arg	Trp	Pro
			405					410						415	
Lys	Ile	Lys	Asn	Leu	Lys	Val	Leu	Ser	Lys	Arg	Trp	Thr	Met	Tyr	Phe
			420					425					430		
Lys	Ala	Lys	Ser	Tyr	Pro	Ser	Gln	Leu	Glu	Leu	Ser	Glu	Gln	Asp	Phe
		435					440					445			
Leu	Glu	Leu	Ala	Ala	Ile	Gln	Phe	Glu	Gln	Glu	Phe	Ser	Val	Pro	Glu
	450					455					460				
Lys	Thr	Asn	Leu	Glu	Met	Val	Leu	Asn	Asp	Lys	Ala	Ile	Ser	Pro	Pro
465					470					475					480
Lys	Arg	Leu	Ile	Trp	Ser	Val	Tyr	Pro	Lys	Asn	Tyr	Leu	Pro	Glu	Lys
			485						490					495	
Ile	Lys	Asn	Arg	Tyr	Leu	Glu	Glu	Thr	Phe	Asn	Ala	Ser	Asp	Ser	Leu
		500						505					510		
Lys	Thr	Arg	Arg	Val	Leu	Glu	Tyr	Tyr	Leu	Lys	Asp	Asn	Lys	Phe	Asp
		515					520					525			
Gln	Lys	Glu	Leu	Lys	Ser	Tyr	Val	Val	Lys	Gln	Glu	Tyr	Leu	Asn	Asp
	530					535					540				
Lys	Asp	His	Ile	Val	Ser	Leu	Thr	Gly	Lys	Glu	Arg	Glu	Leu	Ser	Val
545					550					555					560
Gly	Arg	Met	Phe	Ala	Met	Gln	Pro	Gly	Lys	Gln	Arg	Gln	Ile	Gln	Ile
			565						570					575	
Leu	Ala	Glu	Lys	Leu	Leu	Ala	Asp	Asn	Ile	Val	Pro	Phe	Phe	Pro	Glu
			580					585					590		
Thr	Leu	Thr	Lys	Tyr	Gly	Asp	Leu	Asp	Leu	Gln	Arg	Ile	Met	Glu	Ile
		595				600						605			
Lys	Ser	Glu	Leu	Ser	Ser	Ile	Lys	Thr	Arg	Arg	Asn	Asp	Ser	Tyr	Asn
	610					615					620				
Asn	Tyr	Ile	Ala	Arg	Ala	Ser	Ile	Val	Thr	Asp	Leu	Ser	Lys	Phe	Asn
625					630					635					640
Gln	Ala	Phe	Arg	Tyr	Glu	Thr	Thr	Ala	Ile	Cys	Ala	Asp	Val	Ala	Asp
			645						650					655	
Glu	Leu	His	Gly	Thr	Gln	Ser	Leu	Phe	Cys	Trp	Leu	His	Leu	Ile	Val
		660						665					670		
Pro	Met	Thr	Thr	Met	Ile	Cys	Ala	Tyr	Arg	His	Ala	Pro	Pro	Glu	Thr
		675				680					685				
Lys	Gly	Glu	Tyr	Asp	Ile	Asp	Lys	Ile	Glu	Glu	Gln	Ser	Gly	Leu	Tyr
	690					695					700				
Arg	Tyr	His	Met	Gly	Gly	Ile	Glu	Gly	Trp	Cys	Gln	Lys	Leu	Trp	Thr
705					710					715					720
Met	Glu	Ala	Ile	Ser	Leu	Leu	Asp	Val	Val	Ser	Val	Lys	Thr	Arg	Cys
			725						730					735	
Gln	Met	Thr	Ser	Leu	Leu	Asn	Gly	Asp	Asn	Gln	Ser	Ile	Asp	Val	Ser
			740					745					750		
Lys	Pro	Val	Lys	Leu	Ser	Glu	Gly	Leu	Asp	Glu	Val	Lys	Ala	Asp	Tyr
		755					760					765			
Ser	Leu	Ala	Val	Lys	Met	Leu	Lys	Glu	Ile	Arg	Asp	Ala	Tyr	Arg	Asn
	770					775					780				
Ile	Gly	His	Lys	Leu	Lys	Glu	Gly	Glu	Thr	Tyr	Ile	Ser	Arg	Asp	Leu

785					790					795				800	
Gln	Phe	Ile	Ser	Lys	Val	Ile	Gln	Ser	Glu	Gly	Val	Met	His	Pro	Thr
				805					810					815	
Pro	Ile	Lys	Lys	Ile	Leu	Arg	Val	Gly	Pro	Trp	Ile	Asn	Thr	Ile	Leu
			820					825				830			
Asp	Asp	Ile	Lys	Thr	Ser	Ala	Glu	Ser	Ile	Gly	Ser	Leu	Cys	Gln	Glu
		835					840				845				
Leu	Glu	Phe	Arg	Gly	Glu	Ser	Ile	Ile	Val	Ser	Leu	Ile	Leu	Arg	Asn
	850				855					860					
Phe	Trp	Leu	Tyr	Asn	Leu	Tyr	Met	His	Glu	Ser	Lys	Gln	His	Pro	Leu
865				870					875					880	
Ala	Gly	Lys	Gln	Leu	Phe	Lys	Gln	Leu	Asn	Lys	Thr	Leu	Thr	Ser	Val
			885					890					895		
Gln	Arg	Phe	Phe	Glu	Ile	Lys	Lys	Glu	Asn	Glu	Val	Val	Asp	Leu	Trp
		900					905					910			
Met	Asn	Ile	Pro	Met	Gln	Phe	Gly	Gly	Gly	Asp	Pro	Val	Val	Phe	Tyr
	915				920						925				
Arg	Ser	Phe	Tyr	Arg	Arg	Thr	Pro	Asp	Phe	Leu	Thr	Glu	Ala	Ile	Ser
	930			935						940					
His	Val	Asp	Ile	Leu	Leu	Arg	Ile	Ser	Ala	Asn	Ile	Arg	Asn	Glu	Ala
945				950					955					960	
Lys	Ile	Ser	Phe	Phe	Lys	Ala	Leu	Leu	Ser	Ile	Glu	Lys	Asn	Glu	Arg
			965				970						975		
Ala	Thr	Leu	Thr	Thr	Leu	Met	Arg	Asp	Pro	Gln	Ala	Val	Gly	Ser	Glu
		980					985				990				
Arg	Gln	Ala	Lys	Val	Thr	Ser	Asp	Ile	Asn	Arg	Thr	Ala	Val	Thr	Ser
	995			1000					1005						
Ile	Leu	Ser	Leu	Ser	Pro	Asn	Gln	Leu	Phe	Ser	Asp	Ser	Ala	Ile	His
	1010			1015					1020						
Tyr	Ser	Arg	Asn	Glu	Glu	Glu	Val	Gly	Ile	Ile	Ala	Asp	Asn	Ile	Thr
1025			1030					1035						1040	
Pro	Val	Tyr	Pro	His	Gly	Leu	Arg	Val	Leu	Tyr	Glu	Ser	Leu	Pro	Phe
			1045				1050						1055		
His	Lys	Ala	Glu	Lys	Val	Val	Asn	Met	Ile	Ser	Gly	Thr	Lys	Ser	Ile
	1060			1065					1070						
Thr	Asn	Leu	Gln	Arg	Thr	Ser	Ala	Ile	Asn	Gly	Glu	Asp	Ile	Asp	
	1075			1080					1085						
Arg	Ala	Val	Ser	Met	Met	Leu	Glu	Asn	Leu	Gly	Leu	Leu	Ser	Arg	Ile
	1090			1095					1100						
Leu	Ser	Val	Val	Val	Asp	Ser	Ile	Glu	Ile	Pro	Thr	Lys	Ser	Asn	Gly
1105			1110					1115						1120	
Arg	Leu	Ile	Cys	Cys	Gln	Ile	Ser	Arg	Thr	Leu	Arg	Glu	Thr	Ser	Trp
			1125				1130							1135	
Asn	Asn	Met	Glu	Ile	Val	Gly	Val	Thr	Ser	Pro	Ser	Ile	Thr	Thr	Cys
	1140			1145					1150						
Met	Asp	Val	Ile	Tyr	Ala	Thr	Ser	Ser	His	Leu	Lys	Gly	Ile	Ile	
	1155			1160					1165						
Glu	Lys	Phe	Ser	Thr	Asp	Arg	Thr	Thr	Arg	Gly	Gln	Arg	Gly	Pro	Lys
	1170			1175				1180							
Ser	Pro	Trp	Val	Gly	Ser	Ser	Thr	Gln	Glu	Lys	Lys	Leu	Val	Pro	Val
1185			1190					1195						1200	
Tyr	Asn	Arg	Gln	Ile	Leu	Ser	Lys	Gln	Gln	Arg	Glu	Gln	Leu	Glu	Ala
			1205				1210						1215		
Ile	Gly	Lys	Met	Arg	Trp	Val	Tyr	Lys	Gly	Thr	Pro	Gly	Leu	Arg	Arg
	1220			1225					1230						
Leu	Leu	Asn	Lys	Ile	Cys	Leu	Gly	Ser	Leu	Gly	Ile	Ser	Tyr	Lys	Cys
	1235			1240					1245						
Val	Lys	Pro	Leu	Leu	Pro	Arg	Phe	Met	Ser	Val	Asn	Phe	Leu	His	Arg
	1250			1255					1260						
Leu	Ser	Val	Ser	Ser	Arg	Pro	Met	Glu	Phe	Pro	Ala	Ser	Val	Pro	Ala
1265				1270				1275						1280	

Tyr Arg Thr Thr Asn Tyr His Phe Asp Thr Ser Pro Ile Asn Gln Ala
 1285 1290 1295
 Leu Ser Glu Arg Phe Gly Asn Glu Asp Ile Asn Leu Val Phe Gln Asn
 1300 1305 1310
 Ala Ile Ser Cys Gly Ile Ser Ile Met Ser Val Val Glu Gln Leu Thr
 1315 1320 1325
 Gly Arg Ser Pro Lys Gln Leu Val Leu Ile Pro Gln Leu Glu Glu Ile
 1330 1335 1340
 Asp Ile Met Pro Pro Pro Val Phe Gln Gly Lys Phe Asn Tyr Lys Leu
 1345 1350 1355 1360
 Val Asp Lys Ile Thr Ser Asp Gln His Ile Phe Ser Pro Asp Lys Ile
 1365 1370 1375
 Asp Met Leu Thr Leu Gly Lys Met Leu Met Pro Thr Ile Lys Gly Gln
 1380 1385 1390
 Lys Thr Asp Gln Phe Leu Asn Lys Arg Glu Asn Tyr Phe His Gly Asn
 1395 1400 1405
 Asn Leu Ile Glu Ser Leu Ser Ala Ala Leu Ala Cys His Trp Cys Gly
 1410 1415 1420
 Ile Leu Thr Glu Gln Cys Ile Glu Asn Asn Ile Phe Lys Lys Asp Trp
 1425 1430 1435 1440
 Gly Asp Gly Phe Ile Ser Asp His Ala Phe Met Asp Phe Lys Ile Phe
 1445 1450 1455
 Leu Cys Val Phe Lys Thr Lys Leu Leu Cys Ser Trp Gly Ser Gln Gly
 1460 1465 1470
 Lys Asn Ile Lys Asp Glu Asp Ile Val Asp Glu Ser Ile Asp Lys Leu
 1475 1480 1485
 Leu Arg Ile Asp Asn Thr Phe Trp Arg Met Phe Ser Lys Val Met Phe
 1490 1495 1500
 Glu Ser Lys Val Lys Lys Arg Ile Met Leu Tyr Asp Val Lys Phe Leu
 1505 1510 1515 1520
 Ser Leu Val Gly Tyr Ile Gly Phe Lys Asn Trp Phe Ile Glu Gln Leu
 1525 1530 1535
 Arg Ser Ala Glu Leu His Glu Val Pro Trp Ile Val Asn Ala Glu Gly
 1540 1545 1550
 Asp Leu Val Glu Ile Lys Ser Ile Lys Ile Tyr Leu Gln Leu Ile Glu
 1555 1560 1565
 Gln Ser Leu Phe Leu Arg Ile Thr Val Leu Asn Tyr Thr Asp Met Ala
 1570 1575 1580
 His Ala Leu Thr Arg Leu Ile Arg Lys Lys Leu Met Cys Asp Asn Ala
 1585 1590 1595 1600
 Leu Leu Thr Pro Ile Pro Ser Pro Met Val Asn Leu Thr Gln Val Ile
 1605 1610 1615
 Asp Pro Thr Glu Gln Leu Ala Tyr Phe Pro Lys Ile Thr Phe Glu Arg
 1620 1625 1630
 Leu Lys Asn Tyr Asp Thr Ser Ser Asn Tyr Ala Lys Gly Lys Leu Thr
 1635 1640 1645
 Arg Asn Tyr Met Ile Leu Leu Pro Trp Gln His Val Asn Arg Tyr Asn
 1650 1655 1660
 Phe Val Phe Ser Ser Thr Gly Cys Lys Val Ser Leu Lys Thr Cys Ile
 1665 1670 1675 1680
 Gly Lys Leu Met Lys Asp Leu Asn Pro Lys Val Leu Tyr Phe Ile Gly
 1685 1690 1695
 Glu Gly Ala Gly Asn Trp Met Ala Arg Thr Ala Cys Glu Tyr Pro Asp
 1700 1705 1710
 Ile Lys Phe Val Tyr Arg Ser Leu Lys Asp Asp Leu Asp His His Tyr
 1715 1720 1725
 Pro Leu Glu Tyr Gln Arg Val Ile Gly Glu Leu Ser Arg Ile Ile Asp
 1730 1735 1740
 Ser Gly Glu Gly Leu Ser Met Glu Thr Thr Asp Ala Thr Gln Lys Thr
 1745 1750 1755 1760
 His Trp Asp Leu Ile His Arg Val Ser Lys Asp Ala Leu Leu Ile Thr

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Tyr	Leu	Lys	Gly	Val	Ile	Ser	Phe	Ser	Glu	Thr	Asn	Ala	Ile	Gly	Ser	
			20					25					30			
Cys	Leu	Leu	Lys	Arg	Pro	Tyr	Leu	Lys	Asn	Asp	Asn	Thr	Ala	Lys	Val	
		35					40					45				
Ala	Ile	Glu	Asn	Pro	Val	Ile	Glu	His	Val	Arg	Leu	Lys	Asn	Ala	Val	
	50					55					60					
Asn	Ser	Lys	Met	Lys	Ile	Ser	Asp	Tyr	Lys	Val	Val	Glu	Pro	Val	Asn	
65				70					75					80		
Met	Gln	His	Glu	Ile	Met	Lys	Asn	Val	His	Ser	Cys	Glu	Leu	Thr	Leu	
			85					90						95		
Leu	Lys	Gln	Phe	Leu	Thr	Arg	Ser	Lys	Asn	Ile	Ser	Thr	Leu	Lys	Leu	
			100					105					110			
Asn	Met	Ile	Cys	Asp	Trp	Leu	Gln	Leu	Lys	Ser	Thr	Ser	Asp	Asp	Thr	
		115					120					125				
Ser	Ile	Leu	Ser	Phe	Ile	Asp	Val	Glu	Phe	Ile	Pro	Ser	Trp	Val	Ser	
	130					135					140					
Asn	Trp	Phe	Ser	Asn	Trp	Tyr	Asn	Leu	Asn	Lys	Leu	Ile	Leu	Glu	Phe	
145				150					155					160		
Arg	Arg	Glu	Glu	Val	Ile	Arg	Thr	Gly	Ser	Ile	Leu	Cys	Arg	Ser	Leu	
			165					170						175		

Gly	Lys	Leu	Val	Phe	Ile	Val	Ser	Ser	Tyr	Gly	Cys	Ile	Val	Lys	Ser
			180					185					190		
Asn	Lys	Ser	Lys	Arg	Val	Ser	Phe	Phe	Thr	Tyr	Asn	Gln	Leu	Leu	Thr
		195					200					205			
Trp	Lys	Asp	Val	Met	Leu	Ser	Arg	Phe	Asn	Ala	Asn	Phe	Cys	Ile	Trp
	210					215					220				
Val	Ser	Asn	Ser	Leu	Asn	Glu	Asn	Gln	Glu	Gly	Leu	Gly	Leu	Arg	Ser
225					230					235					240
Asn	Leu	Gln	Gly	Met	Leu	Thr	Asn	Lys	Leu	Tyr	Glu	Thr	Val	Asp	Tyr
				245					250					255	
Met	Leu	Ser	Leu	Cys	Cys	Asn	Glu	Gly	Phe	Ser	Leu	Val	Lys	Glu	Phe
			260					265					270		
Glu	Gly	Phe	Ile	Met	Ser	Glu	Ile	Leu	Arg	Ile	Thr	Glu	His	Ala	Gln
		275					280					285			
Phe	Ser	Thr	Arg	Phe	Arg	Asn	Thr	Leu	Leu	Asn	Gly	Leu	Thr	Asp	Gln
	290					295					300				
Leu	Thr	Lys	Leu	Lys	Asn	Lys	Asn	Arg	Leu	Arg	Val	His	Gly	Thr	Val
305					310					315					320
Leu	Glu	Asn	Asn	Asp	Tyr	Pro	Met	Tyr	Glu	Val	Val	Leu	Lys	Leu	Leu
				325					330					335	
Gly	Asp	Thr	Leu	Arg	Cys	Ile	Lys	Leu	Leu	Ile	Asn	Lys	Asn	Leu	Glu
			340					345					350		
Asn	Ala	Ala	Glu	Leu	Tyr	Tyr	Ile	Phe	Arg	Ile	Phe	Gly	His	Pro	Met
		355					360					365			
Val	Asp	Glu	Arg	Asp	Ala	Met	Asp	Ala	Val	Lys	Leu	Asn	Asn	Glu	Ile
	370					375						380			
Thr	Lys	Ile	Leu	Arg	Leu	Glu	Ser	Leu	Thr	Glu	Leu	Arg	Gly	Ala	Phe
385					390					395					400
Ile	Leu	Arg	Ile	Ile	Lys	Gly	Phe	Val	Asp	Asn	Asn	Lys	Arg	Trp	Pro
				405					410					415	
Lys	Ile	Lys	Asn	Leu	Ile	Val	Leu	Ser	Lys	Arg	Trp	Thr	Met	Tyr	Phe
			420					425					430		
Lys	Ala	Lys	Asn	Tyr	Pro	Ser	Gln	Leu	Glu	Leu	Ser	Glu	Gln	Asp	Phe
		435					440					445			
Leu	Glu	Leu	Ala	Ala	Ile	Gln	Phe	Glu	Gln	Glu	Phe	Ser	Val	Pro	Glu
	450					455					460				
Lys	Thr	Asn	Leu	Glu	Met	Val	Leu	Asn	Asp	Lys	Ala	Ile	Ser	Pro	Pro
465					470					475					480
Lys	Arg	Leu	Ile	Trp	Ser	Val	Tyr	Pro	Lys	Asn	Tyr	Leu	Pro	Glu	Thr
				485					490					495	
Ile	Lys	Asn	Arg	Tyr	Leu	Glu	Glu	Thr	Phe	Asn	Ala	Ser	Asp	Ser	Leu
		500						505					510		
Lys	Thr	Arg	Arg	Val	Leu	Glu	Tyr	Tyr	Leu	Lys	Asp	Asn	Lys	Phe	Asp
		515					520					525			
Gln	Lys	Glu	Leu	Lys	Ser	Tyr	Val	Val	Arg	Gln	Glu	Tyr	Leu	Asn	Asp
	530					535					540				
Lys	Glu	His	Ile	Val	Ser	Leu	Thr	Gly	Lys	Glu	Arg	Glu	Leu	Ser	Val
545					550					555					560
Gly	Arg	Met	Phe	Ala	Met	Gln	Pro	Gly	Lys	Gln	Arg	Gln	Ile	Gln	Ile
				565					570					575	
Leu	Ala	Glu	Lys	Leu	Leu	Ala	Asp	Asn	Ile	Val	Pro	Phe	Phe	Pro	Glu
			580					585					590		
Thr	Leu	Thr	Lys	Tyr	Gly	Asp	Leu	Asp	Leu	Gln	Arg	Ile	Met	Glu	Ile
		595					600						605		
Lys	Ser	Glu	Leu	Ser	Ser	Ile	Lys	Thr	Arg	Arg	Asn	Asp	Ser	Tyr	Asn
	610					615					620				
Asn	Tyr	Ile	Ala	Arg	Ala	Ser	Ile	Val	Thr	Asp	Leu	Ser	Lys	Phe	Asn
625					630					635					640
Gln	Ala	Phe	Arg	Tyr	Glu	Thr	Thr	Ala	Ile	Cys	Ala	Asp	Val	Ala	Asp
				645					650					655	
Glu	Leu	His	Gly	Thr	Gln	Ser	Leu	Phe	Cys	Trp	Leu	His	Leu	Ile	Val

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Met Asp Val Ile Tyr Ala Thr Ser Ser His Leu Lys Gly Ile Ile Ile
 1155 1160 1165
 Glu Lys Phe Ser Thr Asp Arg Thr Thr Arg Gly Gln Arg Gly Pro Lys
 1170 1175 1180
 Ser Pro Trp Val Gly Ser Ser Thr Gln Glu Lys Lys Leu Val Pro Val
 1185 1190 1195 1200
 Tyr Asn Arg Gln Ile Leu Ser Lys Gln Gln Arg Glu Gln Leu Glu Ala
 1205 1210 1215
 Ile Gly Lys Met Arg Trp Val Tyr Lys Gly Thr Pro Gly Leu Arg Arg
 1220 1225 1230
 Leu Leu Asn Lys Ile Cys Leu Gly Ser Leu Gly Ile Ser Tyr Lys Cys
 1235 1240 1245
 Val Lys Pro Leu Leu Pro Arg Phe Met Ser Val Asn Phe Leu His Arg
 1250 1255 1260
 Leu Ser Val Ser Ser Arg Pro Met Glu Phe Pro Ala Ser Val Pro Ala
 1265 1270 1275 1280
 Tyr Arg Thr Thr Asn Tyr His Phe Asp Thr Ser Pro Ile Asn Gln Ala
 1285 1290 1295
 Leu Ser Glu Arg Phe Gly Asn Glu Asp Ile Asn Leu Val Phe Gln Asn
 1300 1305 1310
 Ala Ile Ser Cys Gly Ile Ser Ile Met Ser Val Val Glu Gln Leu Thr
 1315 1320 1325
 Gly Arg Ser Pro Lys Gln Leu Val Leu Ile Pro Gln Leu Glu Glu Ile
 1330 1335 1340
 Asp Ile Met Pro Pro Pro Val Phe Gln Gly Lys Phe Asn Tyr Lys Leu
 1345 1350 1355 1360
 Val Asp Lys Ile Thr Ser Asp Gln His Ile Phe Ser Pro Asp Lys Ile
 1365 1370 1375
 Asp Met Leu Thr Leu Gly Lys Met Leu Met Pro Thr Ile Lys Gly Gln
 1380 1385 1390
 Lys Thr Asp Gln Phe Leu Asn Lys Arg Glu Asn Tyr Phe His Gly Asn
 1395 1400 1405
 Asn Leu Ile Glu Ser Leu Ser Ala Ala Leu Ala Cys His Trp Cys Gly
 1410 1415 1420
 Ile Leu Thr Glu Gln Cys Ile Glu Asn Asn Ile Phe Lys Lys Asp Trp
 1425 1430 1435 1440
 Gly Asp Gly Phe Ile Ser Asp His Ala Phe Met Asp Phe Lys Ile Phe
 1445 1450 1455
 Leu Cys Val Phe Lys Thr Lys Leu Leu Cys Ser Trp Gly Ser Gln Gly
 1460 1465 1470
 Lys Asn Ile Lys Asp Glu Asp Ile Val Asp Glu Ser Ile Asp Lys Leu
 1475 1480 1485
 Leu Arg Ile Asp Asn Thr Phe Trp Arg Met Phe Ser Lys Val Met Phe
 1490 1495 1500
 Glu Pro Lys Val Lys Lys Arg Ile Met Leu Tyr Asp Val Lys Phe Leu
 1505 1510 1515 1520
 Ser Leu Val Gly Tyr Ile Gly Phe Lys Asn Trp Phe Ile Glu Gln Leu
 1525 1530 1535
 Arg Ser Ala Glu Leu His Glu Ile Pro Trp Ile Val Asn Ala Glu Gly
 1540 1545 1550
 Asp Leu Val Glu Ile Lys Ser Ile Lys Ile Tyr Leu Gln Leu Ile Glu
 1555 1560 1565
 Gln Ser Leu Phe Leu Arg Ile Thr Val Leu Asn Tyr Thr Asp Met Ala
 1570 1575 1580
 His Ala Leu Thr Arg Leu Ile Arg Lys Lys Leu Met Cys Asp Asn Ala
 1585 1590 1595 1600
 Leu Leu Thr Pro Ile Ser Ser Pro Met Val Asn Leu Thr Gln Val Ile
 1605 1610 1615
 Asp Pro Thr Thr Gln Leu Asp Tyr Phe Pro Lys Ile Thr Phe Glu Arg
 1620 1625 1630
 Leu Lys Asn Tyr Asp Thr Ser Ser Asn Tyr Ala Lys Gly Lys Leu Thr

1635 1640 1645
 Arg Asn Tyr Met Ile Leu Leu Pro Trp Gln His Val Asn Arg Tyr Asn
 1650 1655 1660
 Phe Val Phe Ser Ser Thr Gly Cys Lys Val Ser Leu Lys Thr Cys Ile
 1665 1670 1675 1680
 Gly Lys Leu Met Lys Asp Leu Asn Pro Lys Val Leu Tyr Phe Ile Gly
 1685 1690 1695
 Glu Gly Ala Gly Asn Trp Met Ala Arg Thr Ala Cys Glu Tyr Pro Asp
 1700 1705 1710
 Ile Lys Phe Val Tyr Arg Ser Leu Lys Asp Asp Leu Asp His His Tyr
 1715 1720 1725
 Pro Leu Glu Tyr Gln Arg Val Ile Gly Glu Leu Ser Arg Ile Ile Asp
 1730 1735 1740
 Ser Gly Glu Gly Leu Ser Met Glu Thr Thr Asp Ala Thr Gln Lys Thr
 1745 1750 1755 1760
 His Trp Asp Leu Ile His Arg Val Ser Lys Asp Ala Leu Leu Ile Thr
 1765 1770 1775
 Leu Cys Asp Ala Glu Phe Lys Asp Arg Asp Asp Phe Phe Lys Met Val
 1780 1785 1790
 Ile Leu Trp Arg Lys His Val Leu Ser Cys Arg Ile Cys Thr Thr Tyr
 1795 1800 1805
 Gly Thr Asp Leu Tyr Leu Phe Ala Lys Tyr His Ala Lys Asp Cys Asn
 1810 1815 1820
 Val Lys Leu Pro Phe Phe Val Arg Ser Val Ala Thr Phe Ile Met Gln
 1825 1830 1835 1840
 Gly Ser Lys Leu Ser Gly Ser Glu Cys Tyr Ile Leu Leu Thr Leu Gly
 1845 1850 1855
 His His Asn Ser Leu Pro Cys His Gly Glu Ile Gln Asn Ser Lys Met
 1860 1865 1870
 Lys Ile Ala Val Cys Asn Asp Phe Tyr Ala Ala Lys Lys Leu Asp Asn
 1875 1880 1885
 Lys Ser Ile Glu Ala Asn Cys Lys Ser Leu Leu Ser Gly Leu Arg Ile
 1890 1895 1900
 Pro Ile Asn Lys Lys Glu Leu Asp Arg Gln Arg Arg Leu Leu Thr Leu
 1905 1910 1915 1920
 Gln Ser Asn His Ser Ser Val Ala Thr Val Gly Gly Ser Lys Ile Ile
 1925 1930 1935
 Glu Ser Lys Trp Leu Thr Asn Lys Ala Ser Thr Ile Ile Asp Trp Leu
 1940 1945 1950
 Glu His Ile Leu Asn Ser Pro Lys Gly Glu Leu Asn Tyr Asp Phe Phe
 1955 1960 1965
 Glu Ala Leu Glu Asn Thr Tyr Pro Asn Met Ile Lys Leu Ile Asp Asn
 1970 1975 1980
 Leu Gly Asn Ala Glu Ile Lys Lys Leu Ile Lys Val Thr Gly Tyr Met
 1985 1990 1995 2000
 Leu Val Ser Lys Lys
 2005

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 Met Asp Pro Phe Cys Glu Ser Thr Val Asn Val Tyr Leu Pro Asp Ser
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 20 25 30
 Cys Leu Leu Lys Arg Pro Tyr Leu Lys Asn Asp Asn Thr Ala Lys Val
 35 40 45

Ala	Val	Glu	Asn	Pro	Val	Val	Glu	His	Val	Arg	Leu	Arg	Asn	Ala	Val
50						55					60				
Met	Thr	Lys	Met	Lys	Ile	Ser	Asp	Tyr	Lys	Val	Val	Glu	Pro	Val	Asn
65					70					75					80
Met	Gln	His	Glu	Ile	Met	Lys	Asn	Ile	His	Ser	Cys	Glu	Leu	Thr	Leu
				85					90					95	
Leu	Lys	Gln	Phe	Leu	Thr	Arg	Ser	Lys	Asn	Ile	Ser	Ser	Leu	Lys	Leu
			100					105					110		
Asn	Met	Ile	Cys	Asp	Trp	Leu	Gln	Leu	Lys	Ser	Thr	Ser	Asp	Asn	Thr
		115					120					125			
Ser	Ile	Leu	Asn	Phe	Ile	Asp	Val	Glu	Phe	Ile	Pro	Val	Trp	Val	Ser
	130					135					140				
Asn	Trp	Phe	Ser	Asn	Trp	Tyr	Asn	Leu	Asn	Lys	Leu	Ile	Leu	Glu	Phe
145					150					155					160
Arg	Arg	Glu	Glu	Val	Ile	Arg	Thr	Gly	Ser	Ile	Leu	Cys	Arg	Ser	Leu
				165					170					175	
Gly	Lys	Leu	Val	Phe	Ile	Val	Ser	Ser	Tyr	Gly	Cys	Val	Val	Lys	Ser
			180					185					190		
Asn	Lys	Ser	Lys	Arg	Val	Ser	Phe	Phe	Thr	Tyr	Asn	Gln	Leu	Leu	Thr
		195					200					205			
Trp	Lys	Asp	Val	Met	Leu	Ser	Arg	Phe	Asn	Ala	Asn	Phe	Cys	Ile	Trp
	210					215					220				
Val	Ser	Asn	Asn	Leu	Asn	Lys	Asn	Gln	Glu	Gly	Leu	Gly	Leu	Arg	Ser
225					230					235					240
Asn	Leu	Gln	Gly	Met	Leu	Thr	Asn	Lys	Leu	Tyr	Glu	Thr	Val	Asp	Tyr
				245					250					255	
Met	Leu	Ser	Leu	Cys	Cys	Asn	Glu	Gly	Phe	Ser	Leu	Val	Lys	Glu	Phe
			260					265					270		
Glu	Gly	Phe	Ile	Met	Ser	Glu	Ile	Leu	Lys	Ile	Thr	Glu	His	Ala	Gln
		275					280					285			
Phe	Ser	Thr	Arg	Phe	Arg	Asn	Thr	Leu	Leu	Asn	Gly	Leu	Thr	Glu	Gln
	290					295					300				
Leu	Ser	Val	Leu	Lys	Ala	Lys	Asn	Arg	Ser	Arg	Val	Leu	Gly	Thr	Ile
305					310					315					320
Leu	Glu	Asn	Asn	Asn	Tyr	Pro	Met	Tyr	Glu	Val	Val	Leu	Lys	Leu	Leu
				325					330					335	
Gly	Asp	Thr	Leu	Lys	Ser	Ile	Lys	Leu	Leu	Ile	Asn	Lys	Asn	Leu	Glu
			340					345					350		
Asn	Ala	Ala	Glu	Leu	Tyr	Tyr	Ile	Phe	Arg	Ile	Phe	Gly	His	Pro	Met
		355					360					365			
Val	Asp	Glu	Arg	Glu	Ala	Met	Asp	Ala	Val	Lys	Leu	Asn	Asn	Glu	Ile
	370					375					380				
Thr	Lys	Ile	Leu	Lys	Leu	Glu	Ser	Leu	Thr	Glu	Leu	Arg	Gly	Ala	Phe
385					390					395					400
Ile	Leu	Arg	Ile	Ile	Lys	Gly	Phe	Val	Asp	Asn	Asn	Lys	Arg	Trp	Pro
				405					410					415	
Lys	Ile	Lys	Asn	Leu	Lys	Val	Leu	Ser	Lys	Arg	Trp	Ala	Met	Tyr	Phe
			420					425					430		
Lys	Ala	Lys	Ser	Tyr	Pro	Ser	Gln	Leu	Glu	Leu	Ser	Val	Gln	Asp	Phe
		435					440					445			
Leu	Glu	Leu	Ala	Ala	Val	Gln	Phe	Glu	Gln	Glu	Phe	Ser	Val	Pro	Glu
	450					455					460				
Lys	Thr	Asn	Leu	Glu	Met	Val	Leu	Asn	Asp	Lys	Ala	Ile	Ser	Pro	Pro
465					470					475					480
Lys	Lys	Leu	Ile	Trp	Ser	Val	Tyr	Pro	Lys	Asn	Tyr	Leu	Pro	Glu	Thr
				485					490					495	
Ile	Lys	Asn	Gln	Tyr	Leu	Glu	Glu	Ala	Phe	Asn	Ala	Ser	Asp	Ser	Gln
		500						505					510		
Arg	Thr	Arg	Arg	Val	Leu	Glu	Phe	Tyr	Leu	Lys	Asp	Cys	Lys	Phe	Asp
		515					520					525			
Gln	Lys	Glu	Leu	Lys	Arg	Tyr	Val	Ile	Lys	Gln	Glu	Tyr	Leu	Asn	Asp

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Lys Asp His Ile Val	Ser Leu Thr Gly Lys	Glu Arg Glu Leu Ser Val
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Gly Arg Met Phe Ala	Met Gln Pro Gly Lys	Gln Arg Gln Ile Gln Ile
565	570	575
Leu Ala Glu Lys Leu	Leu Ala Asp Asn Ile	Val Pro Phe Phe Pro Glu
580	585	590
Thr Leu Thr Lys Tyr	Gly Asp Leu Asp Leu	Gln Arg Ile Met Glu Ile
595	600	605
Lys Ser Glu Leu Ser	Ser Ile Lys Thr Arg	Lys Asn Asp Ser Tyr Asn
610	615	620
Asn Tyr Ile Ala Arg	Ala Ser Ile Val Thr	Asp Leu Ser Lys Phe Asn
625	630	635
Gln Ala Phe Arg Tyr	Glu Thr Thr Ala Ile	Cys Ala Asp Val Ala Asp
645	650	655
Glu Leu His Gly Thr	Gln Ser Leu Phe Cys	Trp Leu His Leu Ile Val
660	665	670
Pro Met Thr Thr Met	Ile Cys Ala Tyr Arg	His Ala Pro Pro Glu Thr
675	680	685
Lys Gly Glu Tyr Asp	Ile Asp Lys Ile Gln	Glu Gln Ser Gly Leu Tyr
690	695	700
Arg Tyr His Met Gly	Gly Ile Glu Gly Trp	Cys Gln Lys Leu Trp Thr
705	710	715
Met Glu Ala Ile Ser	Leu Leu Asp Val Val	Ser Val Lys Thr Arg Cys
725	730	735
Gln Met Thr Ser Leu	Leu Asn Gly Asp Asn	Gln Ser Ile Asp Val Ser
740	745	750
Lys Pro Val Lys Leu	Ser Glu Gly Ile Asp	Glu Val Lys Ala Asp Tyr
755	760	765
Ser Leu Ala Ile Arg	Met Leu Lys Glu Ile	Arg Asp Ala Tyr Lys Asn
770	775	780
Ile Gly His Lys Leu	Lys Glu Gly Glu Thr	Tyr Ile Ser Arg Asp Leu
785	790	795
Gln Phe Ile Ser Lys	Val Ile Gln Ser Glu	Gly Val Met His Pro Thr
805	810	815
Pro Ile Lys Lys Ile	Leu Arg Val Gly Pro	Trp Ile Asn Thr Ile Leu
820	825	830
Asp Asp Ile Lys Thr	Ser Ala Glu Ser Ile	Gly Ser Leu Cys Gln Glu
835	840	845
Leu Glu Phe Arg Gly	Glu Ser Ile Leu Val	Ser Leu Ile Leu Arg Asn
850	855	860
Phe Trp Leu Tyr Asn	Leu Tyr Met Tyr Glu	Ser Lys Gln His Pro Leu
865	870	875
Ala Gly Lys Gln Leu	Phe Lys Gln Leu Asn	Lys Thr Leu Thr Ser Val
885	890	895
Gln Arg Phe Phe Glu	Leu Lys Lys Glu Asn	Asp Val Val Asp Leu Trp
900	905	910
Met Asn Ile Pro Met	Gln Phe Gly Gly Gly	Asp Pro Val Val Phe Tyr
915	920	925
Arg Ser Phe Tyr Arg	Arg Thr Pro Asp Phe	Leu Thr Glu Ala Ile Ser
930	935	940
His Val Asp Leu Leu	Leu Lys Val Ser Asn	Asn Ile Lys Asp Glu Thr
945	950	955
Lys Ile Arg Phe Phe	Lys Ala Leu Leu Ser	Ile Glu Lys Asn Glu Arg
965	970	975
Ala Thr Leu Thr Thr	Leu Met Arg Asp Pro	Gln Ala Val Gly Ser Glu
980	985	990
Arg Gln Ala Lys Val	Thr Ser Asp Ile Asn	Arg Thr Ala Val Thr Ser
995	1000	1005
Ile Leu Ser Leu Ser	Pro Asn Gln Leu Phe	Cys Asp Ser Ala Ile His
1010	1015	1020

Tyr Ser Arg Asn Glu Glu Glu Val Gly Ile Ile Ala Asp Asn Ile Thr
 1025 1030 1035 1040
 Pro Val Tyr Pro His Gly Leu Arg Val Leu Tyr Glu Ser Leu Pro Phe
 1045 1050 1055
 His Lys Ala Glu Lys Val Val Asn Met Ile Ser Gly Thr Lys Ser Ile
 1060 1065 1070
 Thr Asn Leu Leu Gln Arg Thr Ser Ala Ile Asn Gly Glu Asp Ile Asp
 1075 1080 1085
 Arg Ala Val Ser Met Met Leu Glu Asn Leu Gly Leu Leu Ser Arg Ile
 1090 1095 1100
 Leu Ser Val Ile Ile Asn Ser Ile Glu Ile Pro Ile Lys Ser Asn Gly
 1105 1110 1115 1120
 Arg Leu Ile Cys Cys Gln Ile Ser Lys Thr Leu Arg Glu Lys Ser Trp
 1125 1130 1135
 Asn Asn Met Glu Ile Val Gly Val Thr Ser Pro Ser Ile Val Thr Cys
 1140 1145 1150
 Met Asp Val Val Tyr Ala Thr Ser Ser His Leu Lys Gly Ile Ile Ile
 1155 1160 1165
 Glu Lys Phe Ser Thr Asp Lys Thr Thr Arg Gly Gln Arg Gly Pro Lys
 1170 1175 1180
 Ser Pro Trp Val Gly Ser Ser Thr Gln Glu Lys Lys Leu Val Pro Val
 1185 1190 1195 1200
 Tyr Asn Arg Gln Ile Leu Ser Lys Gln Gln Lys Glu Gln Leu Glu Ala
 1205 1210 1215
 Ile Gly Lys Met Arg Trp Val Tyr Lys Gly Thr Pro Gly Leu Arg Arg
 1220 1225 1230
 Leu Leu Asn Lys Ile Cys Ile Gly Ser Leu Gly Ile Ser Tyr Lys Cys
 1235 1240 1245
 Val Lys Pro Leu Leu Pro Arg Phe Met Ser Val Asn Phe Leu His Arg
 1250 1255 1260
 Leu Ser Val Ser Ser Arg Pro Met Glu Phe Pro Ala Ser Val Pro Ala
 1265 1270 1275 1280
 Tyr Arg Thr Thr Asn Tyr His Phe Asp Thr Ser Pro Ile Asn Gln Ala
 1285 1290 1295
 Leu Ser Glu Arg Phe Gly Asn Glu Asp Ile Asn Leu Val Phe Gln Asn
 1300 1305 1310
 Ala Ile Ser Cys Gly Ile Ser Ile Met Ser Val Val Glu Gln Leu Thr
 1315 1320 1325
 Gly Arg Ser Pro Lys Gln Leu Val Leu Ile Pro Gln Leu Glu Glu Ile
 1330 1335 1340
 Asp Ile Met Pro Pro Pro Val Phe Gln Gly Lys Phe Asn Tyr Lys Leu
 1345 1350 1355 1360
 Val Asp Lys Ile Thr Ser Asp Gln His Ile Phe Ser Pro Asp Lys Ile
 1365 1370 1375
 Asp Ile Leu Thr Leu Gly Lys Met Leu Met Pro Thr Ile Lys Gly Gln
 1380 1385 1390
 Lys Thr Asp Gln Phe Leu Asn Lys Arg Glu Asn Tyr Phe His Gly Asn
 1395 1400 1405
 Asn Leu Ile Glu Ser Leu Ser Ala Ala Leu Ala Cys His Trp Cys Gly
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 Gly Asp Gly Phe Ile Ser Asp His Ala Phe Met Asp Phe Lys Val Phe
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 Leu Cys Val Phe Lys Thr Lys Leu Leu Cys Ser Trp Gly Ser Gln Gly
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 Lys Asn Val Lys Asp Glu Asp Ile Ile Asp Glu Ser Ile Asp Lys Leu
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 Leu Arg Ile Asp Asn Thr Phe Trp Arg Met Phe Ser Lys Val Met Phe
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 Glu Ser Lys Val Lys Lys Arg Ile Met Leu Tyr Asp Val Lys Phe Leu

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Arg	Val	Val	Glu	Leu	His	Glu	Val	Pro	Trp	Ile	Val	Asn	Ala	Glu	Gly
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His	Ala	Leu	Thr	Arg	Leu	Ile	Arg	Lys	Lys	Leu	Met	Cys	Asp	Asn	Ala
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Ile	Lys	Phe	Val	Tyr	Arg	Ser	Leu	Lys	Asp	Asp	Leu	Asp	His	His	Tyr
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His	Trp	Asp	Leu	Ile	His	Arg	Ile	Ser	Lys	Asp	Ala	Leu	Leu	Ile	Thr
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Gly	Thr	Asp	Leu	Tyr	Leu	Phe	Ala	Lys	Tyr	His	Ala	Val	Asp	Cys	Asn
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Pro	Ile	Asn	Lys	Lys	Glu	Leu	Asn	Arg	Gln	Lys	Lys	Leu	Leu	Thr	Leu
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Glu	Ser	Lys	Trp	Leu	Lys	Asn	Lys	Ala	Ser	Thr	Ile	Ile	Asp	Trp	Leu
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Glu	His	Ile	Leu	Asn	Ser	Pro	Lys	Gly	Glu	Leu	Asn	Tyr	Asp	Phe	Phe
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Glu	Ala	Leu	Glu	Asn	Thr	Tyr	Pro	Asn	Met	Ile	Lys	Leu	Ile	Asp	Asn
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Leu	Gly	Asn	Ala	Glu	Ile	Lys	Lys	Leu	Ile	Lys	Val	Thr	Gly	Tyr	Met
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															2000

Leu Val Ser Lys Lys
2005

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<211> 2005
<212> PRT
<213> human metapneumo virus

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35 40 45
Ala Val Glu Asn Pro Val Val Glu His Val Arg Leu Arg Asn Ala Val
50 55 60
Met Thr Lys Met Lys Ile Ser Asp Tyr Lys Val Val Glu Pro Ile Asn
65 70 75 80
Met Gln His Glu Ile Met Lys Asn Ile His Ser Cys Glu Leu Thr Leu
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Leu Lys Gln Phe Leu Thr Arg Ser Lys Asn Ile Ser Ser Leu Lys Leu
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Ser Met Ile Cys Asp Trp Leu Gln Leu Lys Ser Thr Ser Asp Asn Thr
115 120 125
Ser Ile Leu Asn Phe Ile Asp Val Glu Phe Ile Pro Val Trp Val Ser
130 135 140
Asn Trp Phe Ser Asn Trp Tyr Asn Leu Asn Lys Leu Ile Leu Glu Phe
145 150 155 160
Arg Arg Glu Glu Val Ile Arg Thr Gly Ser Ile Leu Cys Arg Ser Leu
165 170 175
Gly Lys Leu Val Phe Ile Val Ser Ser Tyr Gly Cys Val Val Lys Ser
180 185 190
Asn Lys Ser Lys Arg Val Ser Phe Phe Thr Tyr Asn Gln Leu Leu Thr
195 200 205
Trp Lys Asp Val Met Leu Ser Arg Phe Asn Ala Asn Phe Cys Ile Trp
210 215 220
Val Ser Asn Asn Leu Asn Lys Asn Gln Glu Gly Leu Gly Phe Arg Ser
225 230 235 240
Asn Leu Gln Gly Met Leu Thr Asn Lys Leu Tyr Glu Thr Val Asp Tyr
245 250 255
Met Leu Ser Leu Cys Ser Asn Glu Gly Phe Ser Leu Val Lys Glu Phe
260 265 270
Glu Gly Phe Ile Met Ser Glu Ile Leu Lys Ile Thr Glu His Ala Gln
275 280 285
Phe Ser Thr Arg Phe Arg Asn Thr Leu Leu Asn Gly Leu Thr Glu Gln
290 295 300
Leu Ser Met Leu Lys Ala Lys Asn Arg Ser Arg Val Leu Gly Thr Ile
305 310 315 320
Leu Glu Asn Asn Asp Tyr Pro Met Tyr Glu Val Val Leu Lys Leu Leu
325 330 335
Gly Asp Thr Leu Lys Ser Ile Lys Leu Leu Ile Asn Lys Asn Leu Glu
340 345 350
Asn Ala Ala Glu Leu Tyr Tyr Ile Phe Arg Ile Phe Gly His Pro Met
355 360 365
Val Asp Glu Arg Glu Ala Met Asp Ala Val Lys Leu Asn Asn Glu Ile
370 375 380
Thr Lys Ile Leu Lys Leu Glu Ser Leu Thr Glu Leu Arg Gly Ala Phe
385 390 395 400
Ile Leu Arg Ile Ile Lys Gly Phe Val Asp Asn Asn Lys Arg Trp Pro

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Gln Arg Phe Phe Glu Leu Lys Lys Glu Asn Asp Val Val Asp Leu Trp
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 Met Asn Ile Pro Met Gln Phe Gly Gly Gly Asp Pro Val Val Phe Tyr
 915 920 925
 Arg Ser Phe Tyr Arg Arg Thr Pro Asp Phe Leu Thr Glu Ala Ile Ser
 930 935 940
 His Val Asp Leu Leu Leu Lys Val Ser Asn Asn Ile Lys Asn Glu Thr
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 Lys Ile Arg Phe Phe Lys Ala Leu Leu Ser Ile Glu Lys Asn Glu Arg
 965 970 975
 Ala Thr Leu Thr Thr Leu Met Arg Asp Pro Gln Ala Val Gly Ser Glu
 980 985 990
 Arg Gln Ala Lys Val Thr Ser Asp Ile Asn Arg Thr Ala Val Thr Ser
 995 1000 1005
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 Tyr Ser Arg Asn Glu Glu Glu Val Gly Ile Ile Ala Asp Asn Ile Thr
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 Pro Val Tyr Pro His Gly Leu Arg Val Leu Tyr Glu Ser Leu Pro Phe
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 1075 1080 1085
 Arg Ala Val Ser Met Met Leu Glu Asn Leu Gly Leu Leu Ser Arg Ile
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 Arg Leu Ile Cys Cys Gln Ile Ser Lys Thr Leu Arg Glu Lys Ser Trp
 1125 1130 1135
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 1140 1145 1150
 Met Asp Val Val Tyr Ala Thr Ser Ser His Leu Lys Gly Ile Ile Ile
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 1170 1175 1180
 Ser Pro Trp Val Gly Ser Ser Thr Gln Glu Lys Lys Leu Val Pro Val
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 Val Lys Pro Leu Leu Pro Arg Phe Met Ser Val Asn Phe Leu His Arg
 1250 1255 1260
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 1265 1270 1275 1280
 Tyr Arg Thr Thr Asn Tyr His Phe Asp Thr Ser Pro Ile Asn Gln Ala
 1285 1290 1295
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 1345 1350 1355 1360
 Val Asp Lys Ile Thr Ser Asp Gln His Ile Phe Ser Pro Asp Lys Ile
 1365 1370 1375
 Asp Ile Leu Thr Leu Gly Lys Met Leu Met Pro Thr Ile Lys Gly Gln

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Arg Ile Ala Val Cys Asn Asp Phe His Ala Ser Lys Lys Leu Asp Asn
 1875 1880 1885
 Lys Ser Ile Glu Ala Asn Cys Lys Ser Leu Leu Ser Gly Leu Arg Ile
 1890 1895 1900
 Pro Ile Asn Lys Lys Glu Leu Asn Arg Gln Lys Lys Leu Leu Thr Leu
 1905 1910 1915 1920
 Gln Ser Asn His Ser Ser Ile Ala Thr Val Gly Gly Ser Lys Ile Ile
 1925 1930 1935
 Glu Ser Lys Trp Leu Lys Asn Lys Ala Ser Thr Ile Ile Asp Trp Leu
 1940 1945 1950
 Glu His Ile Leu Asn Ser Pro Lys Gly Glu Leu Asn Tyr Asp Phe Phe
 1955 1960 1965
 Glu Ala Leu Glu Asn Thr Tyr Pro Asn Met Ile Lys Leu Ile Asp Asn
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 <213> human metapneumo virus

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<400> 335

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<210> 338

<211> 187

<212> PRT

<213> human metapneumo virus

<400> 338

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Met Ser Arg Lys Ala Pro Cys Lys Tyr Glu Val Arg Gly Lys Cys Asn
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Arg Gly Ser Glu Cys Lys Phe Asn His Asn Tyr Trp Ser Trp Pro Asp
 20          25          30
Arg Tyr Leu Ile Arg Ser Asn Tyr Leu Leu Asn Gln Leu Leu Arg
 35          40          45
Asn Thr Asp Arg Ala Asp Gly Leu Ser Ile Ile Ser Gly Ala Gly Arg
 50          55          60
Glu Asp Arg Thr Gln Asp Phe Val Leu Gly Ser Thr Asn Val Val Gln
 65          70          75          80
Gly Tyr Ile Asp Asp Asn Gln Ser Ile Thr Lys Ala Ala Ala Cys Tyr
 85          90          95
Ser Leu His Asn Ile Ile Lys Gln Leu Gln Glu Val Glu Val Arg Gln
100          105          110
Ala Arg Asp Asn Lys Leu Ser Asp Ser Lys His Val Ala Leu His Asn
115          120          125
Leu Val Leu Ser Tyr Met Glu Met Ser Lys Thr Pro Ala Ser Leu Ile
130          135          140
Asn Asn Leu Lys Arg Leu Pro Arg Glu Lys Leu Lys Lys Leu Ala Lys
145          150          155          160
Leu Ile Ile Asp Leu Ser Ala Gly Ala Glu Asn Asp Ser Ser Tyr Ala
165          170          175

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Leu Gln Asp Ser Glu Ser Thr Asn Gln Val Gln
 180 185

<210> 339
 <211> 187
 <212> PRT
 <213> human metapneumo virus.

<400> 339
 Met Ser Arg Lys Ala Pro Cys Lys Tyr Glu Val Arg Gly Lys Cys Asn
 1 5 10 15
 Arg Gly Ser Glu Cys Lys Phe Asn His Asn Tyr Trp Ser Trp Pro Asp
 20 25 30
 Arg Tyr Leu Leu Ile Arg Ser Asn Tyr Leu Leu Asn Gln Leu Leu Arg
 35 40 45
 Asn Thr Asp Arg Ala Asp Gly Leu Ser Ile Ile Ser Gly Ala Gly Arg
 50 55 60
 Glu Asp Arg Thr Gln Asp Phe Val Leu Gly Ser Thr Asn Val Val Gln
 65 70 75 80
 Gly Tyr Ile Asp Asp Asn Gln Ser Ile Thr Lys Ala Ala Ala Cys Tyr
 85 90 95
 Ser Leu His Asn Ile Ile Lys Gln Leu Gln Glu Val Glu Val Arg Gln
 100 105 110
 Ala Arg Asp Ser Lys Leu Ser Asp Ser Lys His Val Ala Leu His Asn
 115 120 125
 Leu Ile Leu Ser Tyr Met Glu Met Ser Lys Thr Pro Ala Ser Leu Ile
 130 135 140
 Asn Asn Leu Lys Arg Leu Pro Arg Glu Lys Leu Lys Lys Leu Ala Lys
 145 150 155 160
 Leu Ile Ile Asp Leu Ser Ala Gly Ala Asp Asn Asp Ser Ser Tyr Ala
 165 170 175
 Leu Gln Asp Ser Glu Ser Thr Asn Gln Val Gln
 180 185

<210> 340
 <211> 187
 <212> PRT
 <213> human metapneumo virus

<400> 340
 Met Ser Arg Lys Ala Pro Cys Lys Tyr Glu Val Arg Gly Lys Cys Asn
 1 5 10 15
 Arg Gly Ser Asp Cys Lys Phe Asn His Asn Tyr Trp Ser Trp Pro Asp
 20 25 30
 Arg Tyr Leu Leu Leu Arg Ser Asn Tyr Leu Leu Asn Gln Leu Leu Arg
 35 40 45
 Asn Thr Asp Lys Ala Asp Gly Leu Ser Ile Ile Ser Gly Ala Gly Arg
 50 55 60
 Glu Asp Arg Thr Gln Asp Phe Val Leu Gly Ser Thr Asn Val Val Gln
 65 70 75 80
 Gly Tyr Ile Asp Asp Asn Gln Gly Ile Thr Lys Ala Ala Ala Cys Tyr
 85 90 95
 Ser Leu His Asn Ile Ile Lys Gln Leu Gln Glu Thr Glu Val Arg Gln
 100 105 110
 Ala Arg Asp Asn Lys Leu Ser Asp Ser Lys His Val Ala Leu His Asn
 115 120 125
 Leu Ile Leu Ser Tyr Met Glu Met Ser Lys Thr Pro Ala Ser Leu Ile
 130 135 140
 Asn Asn Leu Lys Lys Leu Pro Arg Glu Lys Leu Lys Lys Leu Ala Arg

145		150		155		160
Leu Ile Ile Asp	Leu Ser Ala Gly Thr Asp Asn Asp Ser Ser Tyr Ala					
	165		170		175	
Leu Gln Asp Ser Glu Ser Thr Asn Gln Val Gln						
	180		185			

<210> 341
 <211> 187
 <212> PRT
 <213> human metapneumo virus

<400> 341

Met Ser Arg Lys Ala Pro Cys Lys Tyr Glu Val Arg Gly Lys Cys Asn	
1 5 10 15	
Arg Gly Ser Glu Cys Lys Phe Asn His Asn Tyr Trp Ser Trp Pro Asp	
20 25 30	
Arg Tyr Leu Leu Arg Ser Asn Tyr Leu Leu Asn Gln Leu Leu Arg	
35 40 45	
Asn Thr Asp Lys Ala Asp Gly Leu Ser Ile Ile Ser Gly Ala Gly Arg	
50 55 60	
Glu Asp Arg Thr Gln Asp Phe Val Leu Gly Ser Thr Asn Val Val Gln	
65 70 75 80	
Gly Tyr Ile Asp Asn Asn Gln Gly Ile Thr Lys Ala Ala Ala Cys Tyr	
85 90 95	
Ser Leu His Asn Ile Ile Lys Gln Leu Gln Glu Ile Glu Val Arg Gln	
100 105 110	
Ala Arg Asp Asn Lys Leu Ser Asp Ser Lys His Val Ala Leu His Asn	
115 120 125	
Leu Ile Leu Ser Tyr Met Glu Met Ser Lys Thr Pro Ala Ser Leu Ile	
130 135 140	
Asn Asn Leu Lys Lys Leu Pro Arg Glu Lys Leu Lys Lys Leu Ala Lys	
145 150 155 160	
Leu Ile Ile Asp Leu Ser Ala Gly Thr Asp Asn Asp Ser Ser Tyr Ala	
165 170 175	
Leu Gln Asp Ser Glu Ser Thr Asn Gln Val Gln	
180 185	

<210> 342
 <211> 564
 <212> DNA
 <213> human metapneumo virus

<400> 342

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tattttattaa atcaactttt aaggaacact gatagagctg atggccttatc aataatatca	180
ggagcaggca gagaagatag gacacaagat tttgtcctag gttccaccaa tgtggttcaa	240
ggtttatattg atgataacca aagcataaca aaagctgcag cctgttacag tctacataat	300
ataatcaaac aactacaaga agttgaagtt aggcaggcta gagataacaa actatctgac	360
agcaaacatg tagcacttca caacttagtc ctatcttata tggagatgag caaaactcct	420
gcattctttaa tcaacaatct caagagactg ccgagagaga aactgaaaaa attagcaaag	480
ctcataattg acttatcagc aggtgctgaa aatgactctt catatgcctt gcaagacagt	540
gaaagcacta atcaagtgcg gtga	564

<210> 343
 <211> 564
 <212> DNA
 <213> human metapneumo virus

<400> 343

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tatctattaa atcagctttt aaggaacact gatagagctg atggcctatc aataatatca 180
ggcgcaggca gagaagacag aacgcaagat tttgttctag gttccaccaa tgtggttcaa 240
ggttatattg atgataacca aagcataaca aaagctgcag cctgctacag tctacacaac 300
ataatcaagc aactacaaga agttgaagtt aggcaggcta gagatagcaa actatctgac 360
agcaagcatg tggcactcca taacttaatc ttatcttaca tggagatgag caaaactccc 420
gcatctttaa tcaacaatct taaaagactg ccgagagaaa aactgaaaaa attagcaaag 480
ctgataattg acttatcagc aggcgctgac aatgactctt catatgcctt gcaagacagt 540
gaaagcacta atcaagtgcg gtga

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<210> 344

<211> 564

<212> DNA

<213> human metapneumo virus

<400> 344

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tatctcttaa atcagctttt aagaaacaca gataaggctg atggtttgtc aataatatca 180
ggagcaggta gagaagatag aactcaagac tttgttcttg gttctactaa tgtggttcaa 240
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ataatcaagc aactacaaga aacagaagta agacaggcta gagacaacaa gctttctgat 360
agcaaactg tggcgctcca caacttgata ttatcctata tggagatgag caaaactcct 420
gcatctctaa tcaacaacct aaagaaacta ccaagggaaa aactgaagaa attagcaaga 480
ttaataattg atttatcagc aggaactgac aatgactctt catatgcctt gcaagacagt 540
gaaagcacta atcaagtgcg gtaa

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<210> 345

<211> 564

<212> DNA

<213> human metapneumo virus

<400> 345

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agcaaactg tggcacttca caacttgata ttatcctata tggagatgag caaaactcct 420
gcatccctga ttaataacct aaagaaacta ccaagagaaa aactgaagaa attagcgaaa 480
ttaataattg atttatcagc aggaactgat aatgactctt catatgcctt gcaagacagt 540
gaaagcacta atcaagtgcg gtaa

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<210> 346

<211> 71

<212> PRT

<213> human metapneumo virus

<400> 346

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Met Thr Leu His Met Pro Cys Lys Thr Val Lys Ala Leu Ile Lys Cys
1           5           10           15
Ser Glu His Gly Pro Val Phe Ile Thr Ile Glu Val Asp Asp Met Ile
20           25           30
Trp Thr His Lys Asp Leu Lys Glu Ala Leu Ser Asp Gly Ile Val Lys
35           40           45
Ser His Thr Asn Ile Tyr Asn Cys Tyr Leu Glu Asn Ile Glu Ile Ile
50           55           60
Tyr Val Lys Ala Tyr Leu Ser

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65

70

<210> 347
 <211> 71
 <212> PRT
 <213> human metapneumo virus

<400> 347
 Met Thr Leu His Met Pro Cys Lys Thr Val Lys Ala Leu Ile Lys Cys
 1 5 10 15
 Ser Glu His Gly Pro Val Phe Ile Thr Ile Glu Val Asp Glu Met Ile
 20 25 30
 Trp Thr Gln Lys Glu Leu Lys Glu Ala Leu Ser Asp Gly Ile Val Lys
 35 40 45
 Ser His Thr Asn Ile Tyr Asn Cys Tyr Leu Glu Asn Ile Glu Ile Ile
 50 55 60
 Tyr Val Lys Ala Tyr Leu Ser
 65 70

<210> 348
 <211> 71
 <212> PRT
 <213> human metapneumo virus

<400> 348
 Met Thr Leu His Met Pro Cys Lys Thr Val Lys Ala Leu Ile Lys Cys
 1 5 10 15
 Ser Lys His Gly Pro Lys Phe Ile Thr Ile Glu Ala Asp Asp Met Ile
 20 25 30
 Trp Thr His Lys Lys Glu Leu Lys Glu Thr Leu Ser Asp Gly Ile Val Lys
 35 40 45
 Ser His Thr Asn Ile Tyr Ser Cys Tyr Leu Glu Asn Ile Glu Ile Ile
 50 55 60
 Tyr Val Lys Thr Tyr Leu Ser
 65 70

<210> 349
 <211> 71
 <212> PRT
 <213> human metapneumo virus

<400> 349
 Met Thr Leu His Met Pro Cys Lys Thr Val Lys Ala Leu Ile Lys Cys
 1 5 10 15
 Ser Lys His Gly Pro Lys Phe Ile Thr Ile Glu Ala Asp Asp Met Ile
 20 25 30
 Trp Thr His Lys Lys Glu Leu Lys Glu Thr Leu Ser Asp Gly Ile Val Lys
 35 40 45
 Ser His Thr Asn Ile Tyr Ser Cys Tyr Leu Glu Asn Ile Glu Ile Ile
 50 55 60
 Tyr Val Lys Ala Tyr Leu Ser
 65 70

<210> 350
 <211> 216
 <212> DNA
 <213> human metapneumo virus

<400> 350
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 gctttatctg atgggatagt gaagtctcat actaacattt acaattgtta tttagaaaac 180
 atagaaatta tatatgtcaa ggcttactta agtttag 216

<210> 351
 <211> 216
 <212> DNA
 <213> human metapneumo virus

<400> 351
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 gctttgtccg atgggatagt gaagtctcac accaacattt acaattgtta tttagaaaac 180
 atagaaatta tatatgtcaa ggcttactta agtttag 216

<210> 352
 <211> 216
 <212> DNA
 <213> human metapneumo virus

<400> 352
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 cccaaattca ttaccataga ggcagatgat atgatatgga ctcacaaaga attaaaagaa 120
 aactgtctg atgggatagt aaaatcacac accaatattt atagttgtta cttagaaaat 180
 atagaaataa tatatgttaa aacttactta agtttag 216

<210> 353
 <211> 216
 <212> DNA
 <213> human metapneumo virus

<400> 353
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 cccaaattca ttaccataga ggcagatgat atgatatgga cacacaaaga attaaaggag 120
 aactgtctg atgggatagt aaaatcacac accaatattt acagttgtta tttagaaaat 180
 atagaaataa tatatgttaa agcttactta agtttag 216

<210> 354
 <211> 727
 <212> DNA
 <213> human metapneumo virus

<400> 354
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 tatttattaa atcaactttt aaggaacact gatagagctg atggcttatc aataatatca 180
 ggagcaggca gagaagatag gacacaagat tttgtcctag gttccaccaa tgtgggttcaa 240
 gggttatattg atgataacca aagcataaca aaagctgcag cctgttacag tctacataat 300
 ataatacaac aactacaaga agttgaagtt aggcaggcta gagataacaa actatctgac 360
 agcaaactg tagcacttca caacttagtc ctatcttata tggagatgag caaaactcct 420
 gcatctttta tcaacaatct caagagactg ccgagagaga aactgaaaaa attagcaaa 480
 ctcataattg acttatcagc aggtgctgaa aatgactctt catatgcctt gcaagacagt 540
 gaaagcacta atcaagtga gtgagcatgg tccagttttc attactatag aggttgatga 600
 catgatatgg actcacaagg acttaaaaga agctttatct gatgggatag tgaagtctca 660
 tactaacatt tacaattgtt atttagaaaa catagaaatt atatatgtca aggccttactt 720
 aagtttag 727

<210> 355

<211> 727
 <212> DNA
 <213> human metapneumo virus

<400> 355
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 tgtaagttta accacaatta ctggagttgg ccagatagat acttattaat aagatcaaac 120
 tatctattaa atcagctttt aaggaacact gatagagctg atggcctatc aataatatca 180
 ggcgcaggca gagaagacag aacgcaagat tttgttctag gttccaccaa tgtggttcaa 240
 gggttatattg atgataacca aagcataaca aaagctgcag cctgctacag tctacacaac 300
 ataatacaagc aactacaaga agttgaagtt aggcaggcta gagatagcaa actatctgac 360
 agcaagcatg tggcactcca taacttaatc ttatcttaca tggagatgag caaaactccc 420
 gcatctttta tcaacaatct taaaagactg ccgagagaaa aactgaaaaa attagcaaaag 480
 ctgataattg acttatcagc aggcgctgac aatgactctt catatgccct gcaagacagt 540
 gaaagcacta atcaagtgcg gtgagcatgg tcctgttttc attactatag aggttgatga 600
 aatgatattg actcaaaaag aattaaaaga agctttgtcc gatgggatag tgaagtctca 660
 caccaacatt tacaattggt atttagaaaa catagaaatt atatatgtca aggccttactt 720
 aagttag 727

<210> 356
 <211> 727
 <212> DNA
 <213> human metapneumo virus

<400> 356
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 tgcaaattca atcacaatta ctggagttgg cctgatagat atttattggt aagatcaaat 120
 tatctcttaa atcagctttt aagaaacaca gataaggctg atgggttgtc aataatatca 180
 ggagcaggta gagaagatag aactcaagac tttgttcttg gttctactaa tgtggttcaa 240
 gggtacattg atgacaacca aggaataacc aaggctgcag cttgctatag tctacacaac 300
 ataatacaagc aactacaaga aacagaagta agacaggcta gagacaacaa gctttctgat 360
 agcaaactg tggcgctcca caacttgata ttatcctata tggagatgag caaaactcct 420
 gcatctctaa tcaacaacct aaagaaacta ccaagggaaa aactgaagaa attagcaaga 480
 ttaataattg atttatcagc aggaactgac aatgactctt catatgcctt gcaagacagt 540
 gaaagcacta atcaagtgcg gtaaacatgg tcccaaattc attaccatag aggcagatga 600
 tatgatattg actcacaaag aattaaaaga aacactgtct gatgggatag taaaatcaca 660
 caccaatatt tatagttggt acttagaaaa tatagaaata atatatgtta aaacttactt 720
 aagttag 727

<210> 357
 <211> 727
 <212> DNA
 <213> human metapneumo virus

<400> 357
 atgtctcgca aagctccatg caaatatgaa gtacggggca agtgcaacag ggggaagtgag 60
 tgcaaattca accacaatta ctggagctgg cctgataggat atttattggt aagatcaaat 120
 tatctcttga atcagctttt aagaaacact gataaggctg atgggttgtc aataatatca 180
 ggagcaggta gagaagatag gactcaagac tttgttcttg gttctactaa tgtggttcaa 240
 gggtacattg ataacaatca aggaataaca aaggctgcag cttgctatag tctacataac 300
 ataataaaac agctacaaga aatagaagta agacaggcta gagataataa gctttctgac 360
 agcaaactg tggcacttca caacttgata ttatcctata tggagatgag caaaactcct 420
 gcatccctga ttaataacct aaagaaacta ccaagagaaa aactgaagaa attagcgaag 480
 ttaataattg atttatcagc aggaactgat aatgactctt catatgcctt gcaagacagt 540
 gaaagcacta atcaagtgcg gtaagcatgg tcccaaattc attaccatag aggcagatga 600
 tatgatattg acacacaaag aattaaagga gacactgtct gatgggatag taaaatcaca 660
 caccaatatt tacagttggt atttagaaaa tatagaaata atatatgtta aagccttactt 720
 aagttag 727

<210> 358
 <211> 254

<212> PRT

<213> human metapneumo virus

<400> 358

```

Met Glu Ser Tyr Leu Val Asp Thr Tyr Gln Gly Ile Pro Tyr Thr Ala
 1           5           10           15
Ala Val Gln Val Asp Leu Ile Glu Lys Asp Leu Leu Pro Ala Ser Leu
           20           25           30
Thr Ile Trp Phe Pro Leu Phe Gln Ala Asn Thr Pro Pro Ala Val Leu
           35           40           45
Leu Asp Gln Leu Lys Thr Leu Thr Ile Thr Thr Leu Tyr Ala Ala Ser
           50           55           60
Gln Asn Gly Pro Ile Leu Lys Val Asn Ala Ser Ala Gln Gly Ala Ala
65           70           75           80
Met Ser Val Leu Pro Lys Lys Phe Glu Val Asn Ala Thr Val Ala Leu
           85           90           95
Asp Glu Tyr Ser Lys Leu Glu Phe Asp Lys Leu Thr Val Cys Glu Val
           100          105          110
Lys Thr Val Tyr Leu Thr Thr Met Lys Pro Tyr Gly Met Val Ser Lys
           115          120          125
Phe Val Ser Ser Ala Lys Ser Val Gly Lys Lys Thr His Asp Leu Ile
           130          135          140
Ala Leu Cys Asp Phe Met Asp Leu Glu Lys Asn Thr Pro Val Thr Ile
145           150           155           160
Pro Ala Phe Ile Lys Ser Val Ser Ile Lys Glu Ser Glu Ser Ala Thr
           165          170          175
Val Glu Ala Ala Ile Ser Ser Glu Ala Asp Gln Ala Leu Thr Gln Ala
           180          185          190
Lys Ile Ala Pro Tyr Ala Gly Leu Ile Met Ile Met Thr Met Asn Asn
           195          200          205
Pro Lys Gly Ile Phe Lys Lys Leu Gly Ala Gly Thr Gln Val Ile Val
           210          215          220
Glu Leu Gly Ala Tyr Val Gln Ala Glu Ser Ile Ser Lys Ile Cys Lys
225           230           235           240
Thr Trp Ser His Gln Gly Thr Arg Tyr Val Leu Lys Ser Arg
           245           250

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<210> 359

<211> 254

<212> PRT

<213> human metapneumo virus

<400> 359

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Met Glu Ser Tyr Leu Val Asp Thr Tyr Gln Gly Ile Pro Tyr Thr Ala
 1           5           10           15
Ala Val Gln Val Asp Leu Val Glu Lys Asp Leu Leu Pro Ala Ser Leu
           20           25           30
Thr Ile Trp Phe Pro Leu Phe Gln Ala Asn Thr Pro Pro Ala Val Leu
           35           40           45
Leu Asp Gln Leu Lys Thr Leu Thr Ile Thr Thr Leu Tyr Ala Ala Ser
           50           55           60
Gln Ser Gly Pro Ile Leu Lys Val Asn Ala Ser Ala Gln Gly Ala Ala
65           70           75           80
Met Ser Val Leu Pro Lys Lys Phe Glu Val Asn Ala Thr Val Ala Leu
           85           90           95
Asp Glu Tyr Ser Lys Leu Glu Phe Asp Lys Leu Thr Val Cys Glu Val
           100          105          110
Lys Thr Val Tyr Leu Thr Thr Met Lys Pro Tyr Gly Met Val Ser Lys
           115          120          125
Phe Val Ser Ser Ala Lys Ser Val Gly Lys Lys Thr His Asp Leu Ile

```

130		135		140	
Ala Leu Cys Asp Phe Met Asp Leu Glu Lys Asn Thr Pro Val Thr Ile					
145		150		155	160
Pro Ala Phe Ile Lys Ser Val Ser Ile Lys Glu Ser Glu Ser Ala Thr					
	165		170		175
Val Glu Ala Ala Ile Ser Ser Glu Ala Asp Gln Ala Leu Thr Gln Ala					
	180		185		190
Lys Ile Ala Pro Tyr Ala Gly Leu Ile Met Ile Met Thr Met Asn Asn					
	195	200		205	
Pro Lys Gly Ile Phe Lys Lys Leu Gly Ala Gly Thr Gln Val Ile Val					
	210	215		220	
Glu Leu Gly Ala Tyr Val Gln Ala Glu Ser Ile Ser Lys Ile Cys Lys					
225		230		235	240
Thr Trp Ser His Gln Gly Thr Arg Tyr Val Leu Lys Ser Ser					
	245		250		

<210> 360
 <211> 254
 <212> PRT
 <213> human metapneumo virus

<400> 360	
Met Glu Ser Tyr Leu Val Asp Thr Tyr Gln Gly Ile Pro Tyr Thr Ala	
1	5 10 15
Ala Val Gln Val Asp Leu Val Glu Lys Asp Leu Leu Pro Ala Ser Leu	
	20 25 30
Thr Ile Trp Phe Pro Leu Phe Gln Ala Asn Thr Pro Pro Ala Val Leu	
	35 40 45
Leu Asp Gln Leu Lys Thr Leu Thr Ile Thr Thr Leu Tyr Ala Ala Ser	
	50 55 60
Gln Asn Gly Pro Ile Leu Lys Val Asn Ala Ser Ala Gln Gly Ala Ala	
65	70 75 80
Met Ser Val Leu Pro Lys Lys Phe Glu Val Asn Ala Thr Val Ala Leu	
	85 90 95
Asp Glu Tyr Ser Lys Leu Asp Phe Asp Lys Leu Thr Val Cys Asp Val	
	100 105 110
Lys Thr Val Tyr Leu Thr Thr Met Lys Pro Tyr Gly Met Val Ser Lys	
	115 120 125
Phe Val Ser Ser Ala Lys Ser Val Gly Lys Lys Thr His Asp Leu Ile	
	130 135 140
Ala Leu Cys Asp Phe Met Asp Leu Glu Lys Asn Ile Pro Val Thr Ile	
145	150 155 160
Pro Ala Phe Ile Lys Ser Val Ser Ile Lys Glu Ser Glu Ser Ala Thr	
	165 170 175
Val Glu Ala Ala Ile Ser Ser Glu Ala Asp Gln Ala Leu Thr Gln Ala	
	180 185 190
Lys Ile Ala Pro Tyr Ala Gly Leu Ile Met Ile Met Thr Met Asn Asn	
	195 200 205
Pro Lys Gly Ile Phe Lys Lys Leu Gly Ala Gly Thr Gln Val Ile Val	
	210 215 220
Glu Leu Gly Ala Tyr Val Gln Ala Glu Ser Ile Ser Arg Ile Cys Lys	
225	230 235 240
Ser Trp Ser His Gln Gly Thr Arg Tyr Val Leu Lys Ser Arg	
	245 250

<210> 361
 <211> 254
 <212> PRT
 <213> human metapneumo virus

<400> 361
 Met Glu Ser Tyr Leu Val Asp Thr Tyr Gln Gly Ile Pro Tyr Thr Ala
 1 5 10 15
 Ala Val Gln Val Asp Leu Val Glu Lys Asp Leu Leu Pro Ala Ser Leu
 20 25 30
 Thr Ile Trp Phe Pro Leu Phe Gln Ala Asn Thr Pro Pro Ala Val Leu
 35 40 45
 Leu Asp Gln Leu Lys Thr Leu Thr Ile Thr Thr Leu Tyr Ala Ala Ser
 50 55 60
 Gln Asn Gly Pro Ile Leu Lys Val Asn Ala Ser Ala Gln Gly Ala Ala
 65 70 75 80
 Met Ser Val Leu Pro Lys Lys Phe Glu Val Asn Ala Thr Val Ala Leu
 85 90 95
 Asp Glu Tyr Ser Lys Leu Asp Phe Asp Lys Leu Thr Val Cys Asp Val
 100 105 110
 Lys Thr Val Tyr Leu Thr Thr Met Lys Pro Tyr Gly Met Val Ser Lys
 115 120 125
 Phe Val Ser Ser Ala Lys Ser Val Gly Lys Lys Thr His Asp Leu Ile
 130 135 140
 Ala Leu Cys Asp Phe Met Asp Leu Glu Lys Asn Ile Pro Val Thr Ile
 145 150 155 160
 Pro Ala Phe Ile Lys Ser Val Ser Ile Lys Glu Ser Glu Ser Ala Thr
 165 170 175
 Val Glu Ala Ala Ile Ser Ser Glu Ala Asp Gln Ala Leu Thr Gln Ala
 180 185 190
 Lys Ile Ala Pro Tyr Ala Gly Leu Ile Met Ile Met Thr Met Asn Asn
 195 200 205
 Pro Lys Gly Ile Phe Lys Lys Leu Gly Ala Gly Thr Gln Val Ile Val
 210 215 220
 Glu Leu Gly Ala Tyr Val Gln Ala Glu Ser Ile Ser Arg Ile Cys Lys
 225 230 235 240
 Ser Trp Ser His Gln Gly Thr Arg Tyr Val Leu Lys Ser Arg
 245 250

<210> 362
 <211> 765
 <212> DNA
 <213> human metapneumo virus

<400> 362
 atggagtcct acctagtaga cacctatcaa ggcattcctt acacagcagc tgttcaagtt 60
 gatctaataag aaaaggacct gttacctgca agcctaacaa tatgggtccc tttgtttcag 120
 gccaacacac caccagcagt gctgctcgat cagctaaaaa ccctgacaat aaccactctg 180
 tatgctgcat cacaaaatgg tccaatactc aaagtgaatg catcagccca aggtgcagca 240
 atgtctgtac ttcccaaaaa atttgaagtc aatgcgactg tagcactcga tgaatatagc 300
 aaactggaat ttgacaaact cacagtctgt gaagtaaaaa cagttttactt aacaaccatg 360
 aaaccatacg ggatggtatc aaaattttgtg agctcagcca aatcagttgg caaaaaaaca 420
 catgatctaa tcgcactatg tgattttatg gatctagaaa agaacacacc tgttacaata 480
 ccagcattca tcaaatacagt ttcaatcaaa gagagtgagt cagctactgt tgaagctgct 540
 ataagcagtg aagcagacca agctctaaca caggccaaaa ttgcaccta tgcgggatta 600
 attatgatca tgactatgaa caatcccaaa ggcataattca aaaagcttgg agctgggact 660
 caagtcatag tagaactagg agcatatgtc caggctgaaa gcataagcaa aatatgcaag 720
 acttggagacc atcaaggagc aagatatgtc ttgaagtcca gataa 765

<210> 363
 <211> 765
 <212> DNA
 <213> human metapneumo virus

<400> 363

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atggagtcct atctggtaga cacttatcaa ggcattccctt acacagcagc tgttcaagtt 60
gatctagtag aaaaggacct gttacctgca agcctaacaa tatgggttccc cttgtttcag 120
gccaatcac caccagcagt tctgcttgat cagctaaaga ctctgactat aactactctg 180
tatgctgcat cacaaagtgg tccaatacta aaagtgaatg catcagcca ggggtgcagca 240
atgtctgtac ttcccaaaaa gtttgaagtc aatgcgactg tagcacttga cgaatatagc 300
aaattagaat ttgacaaact tacagtctgt gaagtaaaaa cagtttactt aacaaccatg 360
aaaccatatg ggatgggtatc aaagtttgtg agctcggcca aatcagtttg caaaaaaaca 420
catgatctaa tcgcattatg tgattttatg gatctagaaa agaacacacc agttacaata 480
ccagcattta tcaaatacgt ttctatcaag gagagtgaat cagccactgt tgaagctgca 540
ataagcagtg aagcagacca agctctaaca caagccaaaa ttgcacctta tgcgggactg 600
atcatgatta tgaccatgaa caatccaaa ggcataattca agaagcttgg agctgggacc 660
caagttatag tagaactagg agcatatgtc caggctgaaa gcataagtaa aatatgcaag 720
acttgagacc atcaaggaac aagatatgtg ctgaagtcca gttaa 765

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<210> 364

<211> 765

<212> DNA

<213> human metapneumo virus

<400> 364

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atggagtcct atctagtaga cacttatcaa ggcattccat atacagctgc tgttcaagtt 60
gacctggtag aaaaagattt actgccagca agtttgacaa tatgggttccc tttatttcag 120
gccaacacac caccagcagt tctgcttgat cagctaaaaa ccttgacaat aacaactctg 180
tatgctgcat cacagaatgg tccaatactc aaggtaaatg catctgcca aggtgctgcc 240
atgtctgtac ttcccaaaaa attcgaggta aatgcaactg tagcacttga tgaatacagt 300
aaacttgatt ttgacaagct gacggctctgc gatgttaaaa cagtttattt gacaactatg 360
aaaccgtacg ggatgggtgtc aaaatttgtg agttcagcca aatcagtttg caaaaagaca 420
catgatctaa ttgcactatg tgacttcatg gacctagaga aaaatatacc tgtgacaata 480
ccagcattca taaagtcagt ttcaatcaaa gagagtgaat cagccactgt tgaagctgca 540
ataagcagcg aagccgacca agccttgaca caagccaaga ttgcgcccta tgcaggacta 600
attatgatca tgaccatgaa caatccaaa ggtatattca agaaactagg ggctggaaca 660
caagtgatag tagagctggg ggcataatgtt caggctgaga gcatcagtag gatctgcaag 720
agctggagtc accaaggaac aagatacgtc ctaaaatcca gataa 765

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<210> 365

<211> 765

<212> DNA

<213> human metapneumo virus

<400> 365

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atggagtcct atctagtgga cacttatcaa ggcattccct acacagctgc tgttcaagtt 60
gatctggtag aaaaagactt actaccagca agtttgacaa tatgggttccc tctattccaa 120
gccaacacac caccagcggg tttgctcgat cagctaaaaa ccttgactat aacaactctg 180
tatgctgcat cacagaatgg tccaatactc aaagtaaatg catcagctca ggggtgctgct 240
atgtctgtac ttcccaaaaa attcgaagta aatgcaactg tggcacttga tgaatacagc 300
aaacttgact ttgacaagtt aacggtttgc gatgttaaaa cagtttattt gacaaccatg 360
aagccatatg ggatgggtgtc aaaatttgtg agttcagcca aatcagtttg caaaaagaca 420
catgatctaa ttgcactgtg tgacttcatg gacctagaga aaaatatacc tgtgacaata 480
ccagcattca taaagtcagt ttcaatcaaa gagagtgaat cagccactgt tgaagctgca 540
ataagcagtg aggccgacca agcattaaca caagccaaaa ttgcacccta tgcaggacta 600
atcatgatca tgaccatgaa caatccaaa ggtatattca agaaactagg agctggaaca 660
caagtgatag tagagctagg ggcataatgtt caagccgaga gcatcagcag gatctgcaag 720
agctggagtc accaaggaac aagatatgta ctaaaatcca gataa 765

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<210> 366

<211> 394

<212> PRT

<213> human metapneumo virus

<400> 366


```

Met Ser Leu Gln Gly Ile His Leu Ser Asp Leu Ser Tyr Lys His Ala
 1          5          10          15
Ile Leu Lys Glu Ser Gln Tyr Thr Ile Lys Arg Asp Val Gly Thr Thr
 20          25          30
Thr Ala Val Thr Pro Ser Ser Leu Gln Gln Glu Ile Thr Leu Leu Cys
 35          40          45
Gly Glu Ile Leu Tyr Ala Lys His Ala Asp Tyr Lys Tyr Ala Ala Glu
 50          55          60
Ile Gly Ile Gln Tyr Ile Ser Thr Ala Leu Gly Ser Glu Arg Val Gln
 65          70          75          80
Gln Ile Leu Arg Asn Ser Gly Ser Glu Val Gln Val Val Leu Thr Arg
 85          90          95
Thr Tyr Ser Leu Gly Lys Ile Lys Asn Asn Lys Gly Glu Asp Leu Gln
100          105          110
Met Leu Asp Ile His Gly Val Glu Lys Ser Trp Val Glu Glu Ile Asp
115          120          125
Lys Glu Ala Arg Lys Thr Met Ala Thr Leu Leu Lys Glu Ser Ser Gly
130          135          140
Asn Ile Pro Gln Asn Gln Arg Pro Ser Ala Pro Asp Thr Pro Ile Ile
145          150          155          160
Leu Leu Cys Val Gly Ala Leu Ile Phe Thr Lys Leu Ala Ser Thr Ile
165          170          175
Glu Val Gly Leu Glu Thr Thr Val Arg Arg Ala Asn Arg Val Leu Ser
180          185          190
Asp Ala Leu Lys Arg Tyr Pro Arg Met Asp Ile Pro Lys Ile Ala Arg
195          200          205
Ser Phe Tyr Asp Leu Phe Glu Gln Lys Val Tyr His Arg Ser Leu Phe
210          215          220
Ile Glu Tyr Gly Lys Ala Leu Gly Ser Ser Ser Thr Gly Ser Lys Ala
225          230          235          240
Glu Ser Leu Phe Val Asn Ile Phe Met Gln Ala Tyr Gly Ala Gly Gln
245          250          255
Thr Met Leu Arg Trp Gly Val Ile Ala Arg Ser Ser Asn Asn Ile Met
260          265          270
Leu Gly His Val Ser Val Gln Ala Glu Leu Lys Gln Val Thr Glu Val
275          280          285
Tyr Asp Leu Val Arg Glu Met Gly Pro Glu Ser Gly Leu Leu His Leu
290          295          300
Arg Gln Ser Pro Lys Ala Gly Leu Leu Ser Leu Ala Asn Cys Pro Asn
305          310          315          320
Phe Ala Ser Val Val Leu Gly Asn Ala Ser Gly Leu Gly Ile Ile Gly
325          330          335
Met Tyr Arg Gly Arg Val Pro Asn Thr Glu Leu Phe Ser Ala Ala Glu
340          345          350
Ser Tyr Ala Lys Ser Leu Lys Glu Ser Asn Lys Ile Asn Phe Ser Ser
355          360          365
Leu Gly Leu Thr Asp Glu Glu Lys Glu Ala Ala Glu His Phe Leu Asn
370          375          380
Val Ser Asp Asp Ser Gln Asn Asp Tyr Glu
385          390

```

<210> 367

<211> 394

<212> PRT

<213> human metapneumo virus

<400> 367

```

Met Ser Leu Gln Gly Ile His Leu Ser Asp Leu Ser Tyr Lys His Ala
 1          5          10          15
Ile Leu Lys Glu Ser Gln Tyr Thr Ile Lys Arg Asp Val Gly Thr Thr

```

			20					25					30				
Thr	Ala	Val	Thr	Pro	Ser	Ser	Leu	Gln	Gln	Glu	Ile	Thr	Leu	Leu	Cys		
		35					40					45					
Gly	Glu	Ile	Leu	Tyr	Ala	Lys	His	Ala	Asp	Tyr	Lys	Tyr	Ala	Ala	Glu		
	50					55					60						
Ile	Gly	Ile	Gln	Tyr	Ile	Ser	Thr	Ala	Leu	Gly	Ser	Glu	Arg	Val	Gln		
65					70					75					80		
Gln	Ile	Leu	Arg	Asn	Ser	Gly	Ser	Glu	Val	Gln	Val	Val	Leu	Thr	Arg		
			85					90						95			
Thr	Tyr	Ser	Leu	Gly	Lys	Val	Lys	Asn	Asn	Lys	Gly	Glu	Asp	Leu	Gln		
		100						105					110				
Met	Leu	Asp	Ile	His	Gly	Val	Glu	Lys	Ser	Trp	Val	Glu	Glu	Ile	Asp		
		115					120						125				
Lys	Glu	Ala	Arg	Lys	Thr	Met	Ala	Thr	Leu	Leu	Lys	Glu	Ser	Ser	Gly		
	130					135					140						
Asn	Ile	Pro	Gln	Asn	Gln	Arg	Pro	Ser	Ala	Pro	Asp	Thr	Pro	Ile	Ile		
145					150					155					160		
Leu	Leu	Cys	Val	Gly	Ala	Leu	Ile	Phe	Thr	Lys	Leu	Ala	Ser	Thr	Ile		
			165					170						175			
Glu	Val	Gly	Leu	Glu	Thr	Thr	Val	Arg	Arg	Ala	Asn	Arg	Val	Leu	Ser		
			180					185					190				
Asp	Ala	Leu	Lys	Arg	Tyr	Pro	Arg	Met	Asp	Ile	Pro	Lys	Ile	Ala	Arg		
	195					200					205						
Ser	Phe	Tyr	Asp	Leu	Phe	Glu	Gln	Lys	Val	Tyr	Tyr	Arg	Ser	Leu	Phe		
	210				215						220						
Ile	Glu	Tyr	Gly	Lys	Ala	Leu	Gly	Ser	Ser	Ser	Thr	Gly	Ser	Lys	Ala		
225					230					235					240		
Glu	Ser	Leu	Phe	Val	Asn	Ile	Phe	Met	Gln	Ala	Tyr	Gly	Ala	Gly	Gln		
			245					250						255			
Thr	Met	Leu	Arg	Trp	Gly	Val	Ile	Ala	Arg	Ser	Ser	Asn	Asn	Ile	Met		
		260						265					270				
Leu	Gly	His	Val	Ser	Val	Gln	Ala	Glu	Leu	Lys	Gln	Val	Thr	Glu	Val		
	275					280						285					
Tyr	Asp	Leu	Val	Arg	Glu	Met	Gly	Pro	Glu	Ser	Gly	Leu	Leu	His	Leu		
	290				295						300						
Arg	Gln	Ser	Pro	Lys	Ala	Gly	Leu	Leu	Ser	Leu	Ala	Asn	Cys	Pro	Asn		
				310						315					320		
Phe	Ala	Ser	Val	Val	Leu	Gly	Asn	Ala	Ser	Gly	Leu	Gly	Ile	Ile	Gly		
			325					330						335			
Met	Tyr	Arg	Gly	Arg	Val	Pro	Asn	Thr	Glu	Leu	Phe	Ser	Ala	Ala	Glu		
		340						345					350				
Ser	Tyr	Ala	Lys	Ser	Leu	Lys	Glu	Ser	Asn	Lys	Ile	Asn	Phe	Ser	Ser		
		355				360						365					
Leu	Gly	Leu	Thr	Asp	Glu	Glu	Lys	Glu	Ala	Ala	Glu	His	Phe	Leu	Asn		
	370				375						380						
Val	Ser	Asp	Asp	Ser	Gln	Asn	Asp	Tyr	Glu								
385					390												

<210> 368

<211> 394

<212> PRT

<213> human metapneumo virus

<400> 368

Met	Ser	Leu	Gln	Gly	Ile	His	Leu	Ser	Asp	Leu	Ser	Tyr	Lys	His	Ala
1				5					10					15	
Ile	Leu	Lys	Glu	Ser	Gln	Tyr	Thr	Ile	Lys	Arg	Asp	Val	Gly	Thr	Thr
			20					25					30		
Thr	Ala	Val	Thr	Pro	Ser	Ser	Leu	Gln	Gln	Glu	Ile	Thr	Leu	Leu	Cys
		35					40						45		

Gly Glu Ile Leu Tyr Thr Lys His Thr Asp Tyr Lys Tyr Ala Ala Glu
 50 55 60
 Ile Gly Ile Gln Tyr Ile Cys Thr Ala Leu Gly Ser Glu Arg Val Gln
 65 70 75 80
 Gln Ile Leu Arg Asn Ser Gly Ser Glu Val Gln Val Val Leu Thr Lys
 85 90 95
 Thr Tyr Ser Leu Gly Lys Gly Lys Asn Ser Lys Gly Glu Glu Leu Gln
 100 105 110
 Met Leu Asp Ile His Gly Val Glu Lys Ser Trp Ile Glu Glu Ile Asp
 115 120 125
 Lys Glu Ala Arg Lys Thr Met Val Thr Leu Leu Lys Glu Ser Ser Gly
 130 135 140
 Asn Ile Pro Gln Asn Gln Arg Pro Ser Ala Pro Asp Thr Pro Ile Ile
 145 150 155 160
 Leu Leu Cys Val Gly Ala Leu Ile Phe Thr Lys Leu Ala Ser Thr Ile
 165 170 175
 Glu Val Gly Leu Glu Thr Thr Val Arg Arg Ala Asn Arg Val Leu Ser
 180 185 190
 Asp Ala Leu Lys Arg Tyr Pro Arg Ile Asp Ile Pro Lys Ile Ala Arg
 195 200 205
 Ser Phe Tyr Glu Leu Phe Glu Gln Lys Val Tyr Tyr Arg Ser Leu Phe
 210 215 220
 Ile Glu Tyr Gly Lys Ala Leu Gly Ser Ser Ser Thr Gly Ser Lys Ala
 225 230 235 240
 Glu Ser Leu Phe Val Asn Ile Phe Met Gln Ala Tyr Gly Ala Gly Gln
 245 250 255
 Thr Leu Leu Arg Trp Gly Val Ile Ala Arg Ser Ser Asn Asn Ile Met
 260 265 270
 Leu Gly His Val Ser Val Gln Ser Glu Leu Lys Gln Val Thr Glu Val
 275 280 285
 Tyr Asp Leu Val Arg Glu Met Gly Pro Glu Ser Gly Leu Leu His Leu
 290 295 300
 Arg Gln Ser Pro Lys Ala Gly Leu Leu Ser Leu Ala Asn Cys Pro Asn
 305 310 315 320
 Phe Ala Ser Val Val Leu Gly Asn Ala Ser Gly Leu Gly Ile Ile Gly
 325 330 335
 Met Tyr Arg Gly Arg Val Pro Asn Thr Glu Leu Phe Ser Ala Ala Glu
 340 345 350
 Ser Tyr Ala Arg Ser Leu Lys Glu Ser Asn Lys Ile Asn Phe Ser Ser
 355 360 365
 Leu Gly Leu Thr Asp Glu Glu Lys Glu Ala Ala Glu His Phe Leu Asn
 370 375 380
 Met Ser Gly Asp Asn Gln Asn Asp Tyr Glu
 385 390

<210> 369

<211> 394

<212> PRT

<213> human metapneumo virus

<400> 369

Met Ser Leu Gln Gly Ile His Leu Ser Asp Leu Ser Tyr Lys His Ala
 1 5 10 15
 Ile Leu Lys Glu Ser Gln Tyr Thr Ile Lys Arg Asp Val Gly Thr Thr
 20 25 30
 Thr Ala Val Thr Pro Ser Ser Leu Gln Gln Glu Ile Thr Leu Leu Cys
 35 40 45
 Gly Glu Ile Leu Tyr Thr Lys His Thr Asp Tyr Lys Tyr Ala Ala Glu
 50 55 60
 Ile Gly Ile Gln Tyr Ile Cys Thr Ala Leu Gly Ser Glu Arg Val Gln

65					70					75				80	
Gln	Ile	Leu	Arg	Asn	Ser	Gly	Ser	Glu	Val	Gln	Val	Val	Leu	Thr	Lys
				85					90					95	
Thr	Tyr	Ser	Leu	Gly	Lys	Gly	Lys	Asn	Ser	Lys	Gly	Glu	Glu	Leu	Gln
			100					105					110		
Met	Leu	Asp	Ile	His	Gly	Val	Glu	Lys	Ser	Trp	Val	Glu	Glu	Ile	Asp
		115					120					125			
Lys	Glu	Ala	Arg	Lys	Thr	Met	Val	Thr	Leu	Leu	Lys	Glu	Ser	Ser	Gly
	130					135					140				
Asn	Ile	Pro	Gln	Asn	Gln	Arg	Pro	Ser	Ala	Pro	Asp	Thr	Pro	Ile	Ile
145					150					155					160
Leu	Leu	Cys	Val	Gly	Ala	Leu	Ile	Phe	Thr	Lys	Leu	Ala	Ser	Thr	Ile
			165					170						175	
Glu	Val	Gly	Leu	Glu	Thr	Thr	Val	Arg	Arg	Ala	Asn	Arg	Val	Leu	Ser
		180						185					190		
Asp	Ala	Leu	Lys	Arg	Tyr	Pro	Arg	Val	Asp	Ile	Pro	Lys	Ile	Ala	Arg
	195					200					205				
Ser	Phe	Tyr	Glu	Leu	Phe	Glu	Gln	Lys	Val	Tyr	Tyr	Arg	Ser	Leu	Phe
	210				215					220					
Ile	Glu	Tyr	Gly	Lys	Ala	Leu	Gly	Ser	Ser	Ser	Thr	Gly	Ser	Lys	Ala
225			230					235							240
Glu	Ser	Leu	Phe	Val	Asn	Ile	Phe	Met	Gln	Ala	Tyr	Gly	Ala	Gly	Gln
			245					250						255	
Thr	Met	Leu	Arg	Trp	Gly	Val	Ile	Ala	Arg	Ser	Ser	Asn	Asn	Ile	Met
	260							265					270		
Leu	Gly	His	Val	Ser	Val	Gln	Ala	Glu	Leu	Lys	Gln	Val	Thr	Glu	Val
	275					280					285				
Tyr	Asp	Leu	Val	Arg	Glu	Met	Gly	Pro	Glu	Ser	Gly	Leu	Leu	His	Leu
	290				295						300				
Arg	Gln	Ser	Pro	Lys	Ala	Gly	Leu	Leu	Ser	Leu	Ala	Asn	Cys	Pro	Asn
305				310						315					320
Phe	Ala	Ser	Val	Val	Leu	Gly	Asn	Ala	Ser	Gly	Leu	Gly	Ile	Ile	Gly
			325					330						335	
Met	Tyr	Arg	Gly	Arg	Val	Pro	Asn	Thr	Glu	Leu	Phe	Ser	Ala	Ala	Glu
	340							345					350		
Ser	Tyr	Ala	Arg	Ser	Leu	Lys	Glu	Ser	Asn	Lys	Ile	Asn	Phe	Ser	Ser
	355					360					365				
Leu	Gly	Leu	Thr	Asp	Glu	Glu	Lys	Glu	Ala	Ala	Glu	His	Phe	Leu	Asn
	370				375						380				
Met	Ser	Asp	Asp	Asn	Gln	Asp	Asp	Tyr	Glu						
385					390										

<210> 370

<211> 1185

<212> DNA

<213> human metapneumo virus

<400> 370

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caacaagaaa taacactgtt gtgtggagaa attctgtatg ctaaactatgc tgactacaaa 180
tatgctgcag aaataggaat acaatatatt agcacagctt taggatcaga gagagtgcag 240
cagattctga ggaactcagg cagtgaagtc caagtggctc taaccagaac gtactctctg 300
gggaaaatta aaaacaataa aggagaagat ttacagatgt tagacatata cggggtagag 360
aagagctggg tagaagagat agacaaagaa gcaaggaaaa caatggcaac cttgcttaag 420
gaatcatcag gtaatatccc acaaaatcag aggccctcag caccagacac acccataatc 480
ttattatgtg taggtgcctt aatattcact aaactagcat caaccataga agtgggacta 540
gagaccacag tcagaagggc taaccgtgta ctaagtgtat cactcaagag ataccctaga 600
atggacatac caaagattgc cagatccttc tatgacttat ttgaacaaaa agtgtatcac 660
agaagtttgt tcattgagta tggcaaagca ttaggctcat catctacagg cagcaaagca 720

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gaaagtctat	ttgttaatat	attcatgcaa	gcttatgggg	ccggtcaaac	aatgctaagg	780
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gagttaaaac	agggtcacaga	agtctatgac	ttggtgcgag	aaatgggccc	tgaatctgga	900
cttctacatt	taaggcaaag	cccaaaagct	ggactgttat	cactagccaa	ctgtcccaac	960
tttgcaagtg	ttgttctcgg	aaatgcctca	ggcttaggca	taatcggtat	gtatcgaggg	1020
agagtaccaa	acacagaatt	attttcagca	gctgaaagtt	atgccaaaag	tttgaaagaa	1080
agcaataaaa	taaatctctc	ttcattagga	cttacagatg	aagagaaaaga	ggctgcagaa	1140
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<210> 371
 <211> 1185
 <212> DNA
 <213> human metapneumo virus

<400> 371	
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caacaagaaa	taacactatt gtgtggagaa attctatatg ctaagcatgc tgattacaaa 180
tatgctgcag	aaataggaat acaatatatt agcacagctc taggatcaga gagagtacag 240
cagattctaa	gaaactcagg tagtgaagtc caagtggttt taaccagaac gtactccttg 300
gggaaagtta	aaaacaacaa aggagaagat ttacagatgt tagacatata cggagtagag 360
aaaagctggg	tggagagat agacaaagaa gcaagaaaaa caatggcaac tttgcttaaa 420
gaatcatcag	gcaatattcc acaaaatcag aggccttcag caccagacac acccataatc 480
ttattatgtg	taggtgcctt aatatttacc aaactagcat caactataga agtgggatta 540
gagaccacag	tcagaagagc taaccgtgta ctaagtgatg cactcaaaaag ataccctagg 600
atggacatac	caaaaatcgc tagatctttc tatgacttat ttgaacaaaa agtgtattac 660
agaagtttgt	tcattgagta tggcaaagca ttaggtctcat cctctacagg cagcaaagca 720
gaaagtttat	tcgttaatat attcatgcaa gcttacgggtg ctgggtcaaac aatgctgagg 780
tggtggagtc	ttgccaggtc atctaacaat ataatgttag gacatgtatc tgttcaagct 840
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tttgctagtg	ttgttctcgg caatgcctca ggcttaggca taataggtat gtatcgcggg 1020
agagtgccaa	acacagaact attttcagca gcagaaagct atgccaaagag tttgaaagaa 1080
agcaataaaa	ttaacttttc ttcattagga ctacacagatg aagaaaaaga ggctgcagaa 1140
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<210> 372
 <211> 1185
 <212> DNA
 <213> human metapneumo virus

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caacaagaaa	taacactttt gtgtggggaa atacttttaca ctaaaccacac tgattacaaa 180
tatgctgctg	agataggaat acaatatatt tgcacagctc taggatcaga aagagtacaa 240
cagattttga	gaaactcagg tagtgaagtt caggtgggtt taaccaaaac atactcctta 300
gggaaaggca	aaaacagtaa aggggaagag ctgcagatgt tagatataca tggagtggaa 360
aagagttgga	tagaagaaat agacaaagag gcaagaaaga caatggtaac tttgcttaag 420
gaatcatcag	gtaacatccc acaaaaccag agaccttcag caccagacac accaataatt 480
ttattatgtg	taggtgcctt aatattcact aaactagcat caacaataga agttggatta 540
gagactacag	ttagaagagc taatagagtg ctaagtgatg cactcaaaaag ataccctagg 600
atagatatag	caaagattgc tagatctttt tatgaactat ttgaacaaaa agtgtactac 660
agaagtttat	tcattgagta cggaagagct ttaggtctcat cttcaacagg aagcaaagca 720
gaaagtttgt	ttgtaaatat atttatgcaa gcttatggag ctggccaaaac actgctaagg 780
tggtgtgtca	ttgccagatc atccaacaac ataatgctag ggcatgtatc tgtgcaatct 840
gaattgaagc	aagttacaga ggtttatgac ttggtgagag aaatgggtcc tgaatctggg 900
cttttacatc	taagacaaag tccaaaggca gggctgttat cattggccaa ttgccccaat 960
tttgctagtg	ttgttcttgg caatgcttca ggtctaggca taatcggaat gtacagaggg 1020
agagtaccaa	acacagagct attttctgca gcagaaagtt atgccagaag cttaaaagaa 1080
agcaataaaa	tcaacttctc ttcgttaggg cttacagatg aagaaaaaga agctgcagaa 1140

cacttcttaa acatgagtgg tgacaatcaa aatgattatg agtaa

1185

<210> 373

<211> 1185

<212> DNA

<213> human metapneumo virus

<400> 373

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cagcaagaga taacacttttt gtgtgggagag attcttttaca ctaaacatac tgattacaaa 180
tatgctgcag agatagggat acaatatatt tgcacagctc taggatcaga aagagtacaa 240
cagatttttaa gaaattcagg tagtgagggtt cagggtggttc taaccaagac atactcttta 300
gggaaaggta aaaatagtaa aggggaagag ttgcaaagt tagatataca tggagtggaa 360
aagagttggg tagaagaaat agacaaagag gcaagaaaaa caatggtgac tttgctaaag 420
gaatcatcag gcaacatccc acaaaaccag aggcccttcag caccagacac accaataatt 480
ttattgtgtg taggtgcttt aatattcact aaactagcat caacaataga agttggacta 540
gagactacag ttagaagggc taacagagtg ttaagtgatg cgctcaaaag ataccctagg 600
gtagatatac caaagattgc tagatctttt tatgaactat ttgagcagaa agtgtattac 660
aggagtctat tcattgagta tgggaaagct ttaggctcat cttcaacagg aagcaaagca 720
gaaagtttgt ttgtaaatat atttatgcaa gcttatggag ccggtcagac aatgctaagg 780
tgggggtgtc ttgccagatc atctaacaac ataatgctag ggcatgtatc tgtgcaagct 840
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agcaacaaaa tcaacttctc ctcattaggg ctcacagacg aagaaaaaga agctgcagaa 1140
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<210> 374

<211> 294

<212> PRT

<213> human metapneumo virus

<400> 374

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Met Ser Phe Pro Glu Gly Lys Asp Ile Leu Phe Met Gly Asn Glu Ala
1           5           10           15
Ala Lys Leu Ala Glu Ala Phe Gln Lys Ser Leu Arg Lys Pro Gly His
20          25          30
Lys Arg Ser Gln Ser Ile Ile Gly Glu Lys Val Asn Thr Val Ser Glu
35          40          45
Thr Leu Glu Leu Pro Thr Ile Ser Arg Pro Ala Lys Pro Thr Ile Pro
50          55          60
Ser Glu Pro Lys Leu Ala Trp Thr Asp Lys Gly Glu Ala Thr Lys Thr
65          70          75          80
Glu Ile Lys Gln Ala Ile Lys Val Met Asp Pro Ile Glu Glu Glu Glu
85          90          95
Ser Thr Glu Lys Lys Val Leu Pro Ser Ser Asp Gly Lys Thr Pro Ala
100         105         110
Glu Lys Lys Leu Lys Pro Ser Thr Asn Thr Lys Lys Lys Val Ser Phe
115         120         125
Thr Pro Asn Glu Pro Gly Lys Tyr Thr Lys Leu Glu Lys Asp Ala Leu
130         135         140
Asp Leu Leu Ser Asp Asn Glu Glu Glu Asp Ala Glu Ser Ser Ile Leu
145         150         155         160
Thr Phe Glu Glu Arg Asp Thr Ser Ser Leu Ser Ile Glu Ala Arg Leu
165         170         175
Glu Ser Ile Glu Glu Lys Leu Ser Met Ile Leu Gly Leu Leu Arg Thr
180         185         190
Leu Asn Ile Ala Thr Ala Gly Pro Thr Ala Ala Arg Asp Gly Ile Arg
195         200         205

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Asp Ala Met Ile Gly Val Arg Glu Glu Leu Ile Ala Asp Ile Ile Lys
 210 215 220
 Glu Ala Lys Gly Lys Ala Ala Glu Met Met Glu Glu Glu Met Ser Gln
 225 230 235 240
 Arg Ser Lys Ile Gly Asn Gly Ser Val Lys Leu Thr Glu Lys Ala Lys
 245 250 255
 Glu Leu Asn Lys Ile Val Glu Asp Glu Ser Thr Ser Gly Glu Ser Glu
 260 265 270
 Glu Glu Glu Glu Pro Lys Asp Thr Gln Asp Asn Ser Gln Glu Asp Asp
 275 280 285
 Ile Tyr Gln Leu Ile Met
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<210> 375

<211> 294

<212> PRT

<213> human metapneumo virus

<400> 375

Met Ser Phe Pro Glu Gly Lys Asp Ile Leu Phe Met Gly Asn Glu Ala
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 Ala Lys Leu Ala Glu Ala Phe Gln Lys Ser Leu Arg Lys Pro Asn His
 20 25 30
 Lys Arg Ser Gln Ser Ile Ile Gly Glu Lys Val Asn Thr Val Ser Glu
 35 40 45
 Thr Leu Glu Leu Pro Thr Ile Ser Arg Pro Thr Lys Pro Thr Ile Leu
 50 55 60
 Ser Glu Pro Lys Leu Ala Trp Thr Asp Lys Gly Gly Ala Ile Lys Thr
 65 70 75 80
 Glu Ala Lys Gln Thr Ile Lys Val Met Asp Pro Ile Glu Glu Glu Glu
 85 90 95
 Phe Thr Glu Lys Arg Val Leu Pro Ser Ser Asp Gly Lys Thr Pro Ala
 100 105 110
 Glu Lys Lys Leu Lys Pro Ser Thr Asn Thr Lys Lys Lys Val Ser Phe
 115 120 125
 Thr Pro Asn Glu Pro Gly Lys Tyr Thr Lys Leu Glu Lys Asp Ala Leu
 130 135 140
 Asp Leu Leu Ser Asp Asn Glu Glu Glu Asp Ala Glu Ser Ser Ile Leu
 145 150 155 160
 Thr Phe Glu Glu Arg Asp Thr Ser Ser Leu Ser Ile Glu Ala Arg Leu
 165 170 175
 Glu Ser Ile Glu Glu Lys Leu Ser Met Ile Leu Gly Leu Leu Arg Thr
 180 185 190
 Leu Asn Ile Ala Thr Ala Gly Pro Thr Ala Ala Arg Asp Gly Ile Arg
 195 200 205
 Asp Ala Met Ile Gly Ile Arg Glu Glu Leu Ile Ala Asp Ile Ile Lys
 210 215 220
 Glu Ala Lys Gly Lys Ala Ala Glu Met Met Glu Glu Glu Met Asn Gln
 225 230 235 240
 Arg Thr Lys Ile Gly Asn Gly Ser Val Lys Leu Thr Glu Lys Ala Lys
 245 250 255
 Glu Leu Asn Lys Ile Val Glu Asp Glu Ser Thr Ser Gly Glu Ser Glu
 260 265 270
 Glu Glu Glu Glu Pro Lys Asp Thr Gln Glu Asn Asn Gln Glu Asp Asp
 275 280 285
 Ile Tyr Gln Leu Ile Met
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<210> 376

<211> 294
 <212> PRT
 <213> human metapneumo virus

<400> 376

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Met Ser Phe Pro Glu Gly Lys Asp Ile Leu Phe Met Gly Asn Glu Ala
 1           5           10           15
Ala Lys Ile Ala Glu Ala Phe Gln Lys Ser Leu Lys Lys Ser Gly His
          20           25           30
Lys Arg Thr Gln Ser Ile Val Gly Glu Lys Val Asn Thr Ile Ser Glu
          35           40           45
Thr Leu Glu Leu Pro Thr Ile Ser Lys Pro Ala Arg Ser Ser Thr Leu
          50           55           60
Leu Glu Pro Lys Leu Ala Trp Ala Asp Asn Ser Gly Ile Thr Lys Ile
65           70           75           80
Thr Glu Lys Pro Ala Thr Lys Thr Thr Asp Pro Val Glu Glu Glu Glu
          85           90           95
Phe Asn Glu Lys Lys Val Leu Pro Ser Ser Asp Gly Lys Thr Pro Ala
          100          105          110
Glu Lys Lys Ser Lys Phe Ser Thr Ser Val Lys Lys Lys Val Ser Phe
          115          120          125
Thr Ser Asn Glu Pro Gly Lys Tyr Thr Lys Leu Glu Lys Asp Ala Leu
          130          135          140
Asp Leu Leu Ser Asp Asn Glu Glu Glu Asp Ala Glu Ser Ser Ile Leu
145          150          155          160
Thr Phe Glu Glu Lys Asp Thr Ser Ser Leu Ser Ile Glu Ala Arg Leu
          165          170          175
Glu Ser Ile Glu Glu Lys Leu Ser Met Ile Leu Gly Leu Leu Arg Thr
          180          185          190
Leu Asn Ile Ala Thr Ala Gly Pro Thr Ala Ala Arg Asp Gly Ile Arg
          195          200          205
Asp Ala Met Ile Gly Ile Arg Glu Glu Leu Ile Ala Glu Ile Ile Lys
210          215          220
Glu Ala Lys Gly Lys Ala Ala Glu Met Met Glu Glu Glu Met Asn Gln
225          230          235          240
Arg Ser Lys Ile Gly Asn Gly Ser Val Lys Leu Thr Glu Lys Ala Lys
          245          250          255
Glu Leu Asn Lys Ile Val Glu Asp Glu Ser Thr Ser Gly Glu Ser Glu
          260          265          270
Glu Glu Glu Glu Pro Lys Glu Thr Gln Asp Asn Asn Gln Gly Glu Asp
          275          280          285
Ile Tyr Gln Leu Ile Met
          290

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<210> 377
 <211> 294
 <212> PRT
 <213> human metapneumo virus

<400> 377

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Met Ser Phe Pro Glu Gly Lys Asp Ile Leu Phe Met Gly Asn Glu Ala
 1           5           10           15
Ala Lys Ile Ala Glu Ala Phe Gln Lys Ser Leu Lys Arg Ser Gly His
          20           25           30
Lys Arg Thr Gln Ser Ile Val Gly Glu Lys Val Asn Thr Ile Ser Glu
          35           40           45
Thr Leu Glu Leu Pro Thr Ile Ser Lys Pro Ala Arg Ser Ser Thr Leu
          50           55           60
Leu Glu Pro Lys Leu Ala Trp Ala Asp Ser Ser Gly Ala Thr Lys Thr
65           70           75           80

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Thr Glu Lys Gln Thr Thr Lys Thr Thr Asp Pro Val Glu Glu Glu Glu
 85 90 95
 Leu Asn Glu Lys Lys Val Ser Pro Ser Ser Asp Gly Lys Thr Pro Ala
 100 105 110
 Glu Lys Lys Ser Lys Ser Pro Thr Asn Val Lys Lys Lys Val Ser Phe
 115 120 125
 Thr Ser Asn Glu Pro Gly Lys Tyr Thr Lys Leu Glu Lys Asp Ala Leu
 130 135 140
 Asp Leu Leu Ser Asp Asn Glu Glu Glu Asp Ala Glu Ser Ser Ile Leu
 145 150 155 160
 Thr Phe Glu Glu Arg Asp Thr Ser Ser Leu Ser Ile Glu Ala Arg Leu
 165 170 175
 Glu Ser Ile Glu Glu Lys Leu Ser Met Ile Leu Gly Leu Leu Arg Thr
 180 185 190
 Leu Asn Ile Ala Thr Ala Gly Pro Thr Ala Ala Arg Asp Gly Ile Arg
 195 200 205
 Asp Ala Met Ile Gly Ile Arg Glu Glu Leu Ile Ala Glu Ile Ile Lys
 210 215 220
 Glu Ala Lys Gly Lys Ala Ala Glu Met Met Glu Glu Met Asn Gln
 225 230 235 240
 Arg Ser Lys Ile Gly Asn Gly Ser Val Lys Leu Thr Glu Lys Ala Lys
 245 250 255
 Glu Leu Asn Lys Ile Val Glu Asp Glu Ser Thr Ser Gly Glu Ser Glu
 260 265 270
 Glu Glu Glu Glu Pro Lys Glu Thr Gln Asp Asn Asn Gln Gly Glu Asp
 275 280 285
 Ile Tyr Gln Leu Ile Met
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<210> 378
 <211> 885
 <212> DNA
 <213> human metapneumo virus

<400> 378
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 gaaaaagtga atactgtatc agaaacattg gaattaccta ctatcagtag acctgcaaaa 180
 ccaaccatac cgtcagaacc aaagttagca tggacagata aaggtggggc aacccaaaact 240
 gaaataaagc aagcaatcaa agtcatggat cccattgaag aagaagagtc taccgagaag 300
 aaggtgctac cctccagtga tgggaaaacc cctgcagaaa agaaactgaa accatcaact 360
 aacacaaaaa agaagggttc atttacacca aatgaaccag ggaaatatac aaagttggaa 420
 aaagatgctc tagattttgct ctcagataat gaagaagaag atgcagaatc ttcaatctta 480
 acctttgaag aaagagatac ttcattcatta agcattgagg ccagattgga atcaatagag 540
 gagaaattaa gcatgatatt agggctatta agaacactca acattgctac agcaggaccc 600
 acagcagcaa gagatgggat cagagatgca atgattggcg taagagagga attaatagca 660
 gacataataa aggaagctaa agggaaagca gcagaaatga tggaaagagga aatgagtcaa 720
 cgatcaaaaa taggaaatgg tagtgtaaaa ttaacagaaa aagcaaaaga gctcaacaaa 780
 attgttgaag atgaaagcac aagtggagaa tccgaagaag aagaagaacc aaaagacaca 840
 caagacaata gtcaagaaga tgacatttac cagttaatta tgtag 885

<210> 379
 <211> 885
 <212> DNA
 <213> human metapneumo virus

<400> 379
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 gaagcttttc aaaaatcatt aagaaaacct aatcataaaa gatctcaatc tattatagga 120
 gaaaaagtga acactgtatc tgaacattg gaattaccta ctatcagtag acctacaaa 180

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ccgaccatat  tgtcagagcc  gaagtttagca  tggacagaca  aaggtggggc  aatcaaaact  240
gaagcaaaagc  aaacaatcaa  agttatggat  cctattgaag  aagaagagtt  tactgagaaa  300
agggtgctgc  cctccagtga  tgggaaaact  cctgcagaaa  agaagttgaa  accatcaacc  360
aacactaaaa  agaaggtctc  atttacacca  aatgaaccag  gaaaatacac  aaagttggag  420
aaagatgctc  tagacttgct  ttcagacaat  gaagaagaag  atgcagaatc  ctcaatctta  480
accttcgaag  aaagagatac  ttcattcatta  agcattgaag  ccagactaga  atcgattgag  540
gagaaattaa  gcatgatatt  agggctatta  agaacactca  acattgctac  agcaggaccc  600
acagcagcaa  gagatgggat  cagagatgca  atgattggca  taagggagga  actaatagca  660
gacataataa  aagaagccaa  gggaaaagca  gcagaaatga  tggaagaaga  aatgaaccag  720
cggacaaaaa  taggaaacgg  tagtgtaaaa  ttaactgaaa  aggcaaagga  gctcaacaaa  780
attgttgaa  acgaaagcac  aagtggtgaa  tccgaagaag  aagaagaacc  aaaagacaca  840
caggaaaata  atcaagaaga  tgacattttac  cagtttaatta  tgtag  885

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<210> 380

<211> 885

<212> DNA

<213> human metapneumo virus

<400> 380

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gaaaaagtta  acactatata  agaaactcta  gaactaccta  ccatcagcaa  acctgcacga  180
tcatctacac  tgctggaacc  aaaattggca  tgggcagaca  acagcggaat  caccaaaatc  240
acagaaaaac  cagcaaccaa  aacaacagat  cctgttgaa  aagaggaatt  caatgaaaag  300
aaagtgttac  cttccagtga  tgggaagact  cctgcagaga  aaaaatcaaa  gttttcaacc  360
agtgtaaaaa  agaaagtttc  ctttacatca  aatgaaccag  ggaaatacac  caaactagag  420
aaagatgccc  tagatttgct  ctcagacaat  gaggaagaag  acgcagaatc  ctcaatccta  480
acttttgagg  agaaagatac  atcatcacta  agcattgaag  ctgactaga  atctatagaa  540
gagaagttga  gcatgatatt  aggactgctt  cgtacactta  acattgcaac  agcaggacca  600
acagctgcac  gagatggaat  tagggatgca  atgattggta  taagagaaga  gctaatagca  660
gagataatta  aggaagccaa  gggaaaagca  gctgaaatga  tggaagaaga  gatgaatcaa  720
agatcaaaaa  taggaaatgg  cagtgtaaaa  ctaaccgaga  aggcaaaaga  gctcaacaaa  780
attgttgaa  acgagagcac  aagcggtgaa  tcagaagaag  aagaagaacc  aaaagaaact  840
caggataaca  atcaaggaga  agatattttat  cagtttaatca  tgtag  885

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<210> 381

<211> 885

<212> DNA

<213> human metapneumo virus

<400> 381

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gaaaaagtta  acactatata  agaaactcta  gagctaccta  ccatcagcaa  acctgcacga  180
tcatctacac  tgctagagcc  aaaattggca  tgggcagaca  gcagcggagc  caccaaaacc  240
acagaaaaac  aaacaaccaa  aacaacagat  cctgttgaa  aagaggaact  caatgaaaag  300
aaggtatcac  cttccagtga  tgggaagact  cctgcagaga  aaaaatcaaa  atctccaacc  360
aatgtaaaaa  agaaagtttc  cttcacatca  aatgaaccag  ggaaatatac  taaactagaa  420
aaagatgccc  tagatttgct  ctcagacaat  gaggaagaag  acgcagagtc  ctcaatccta  480
acctttgaag  agagagacac  atcatcacta  agcattgagg  ctgactaga  atcaatagaa  540
gagaagctaa  gcatgatatt  aggactgctt  cgtacactta  acattgcaac  agcaggacca  600
acggctgcaa  gggatggaat  cagagatgca  atgattggta  taagagaaga  actaatagca  660
gaaataataa  aagaagcaaa  gggaaaagca  gccgaaatga  tggaagagga  aatgaatcaa  720
aggtcaaaaa  taggtaatgg  cagtgtaaaa  ctaaccgaga  aggcaaaaga  acttaataaa  780
attgttgaa  acgagagcac  aagtggtgaa  tcagaagaag  aagaagaacc  aaaagaaact  840
caggataaca  atcaaggaga  agatatctac  cagtttaatca  tgtag  885

```

<210> 382

<211> 183

<212> PRT

<213> human metapneumo virus

<400> 382

```

Met Ile Thr Leu Asp Val Ile Lys Ser Asp Gly Ser Ser Lys Thr Cys
 1           5           10           15
Thr His Leu Lys Lys Ile Ile Lys Asp His Ser Gly Lys Val Leu Ile
      20           25           30
Val Leu Lys Leu Ile Leu Ala Leu Leu Thr Phe Leu Thr Val Thr Ile
      35           40           45
Thr Ile Asn Tyr Ile Lys Val Glu Asn Asn Leu Gln Ile Cys Gln Ser
 50           55           60
Lys Thr Glu Ser Asp Lys Lys Asp Ser Ser Ser Asn Thr Thr Ser Val
65           70           75           80
Thr Thr Lys Thr Thr Leu Asn His Asp Ile Thr Gln Tyr Phe Lys Ser
      85           90           95
Leu Ile Gln Arg Tyr Thr Asn Ser Ala Ile Asn Ser Asp Thr Cys Trp
      100          105          110
Lys Ile Asn Arg Asn Gln Cys Thr Asn Ile Thr Thr Tyr Lys Phe Leu
      115          120          125
Cys Phe Lys Ser Glu Asp Thr Lys Thr Asn Asn Cys Asp Lys Leu Thr
130          135          140
Asp Leu Cys Arg Asn Lys Pro Lys Pro Ala Val Gly Val Tyr His Ile
145          150          155          160
Val Glu Cys His Cys Ile Tyr Thr Val Lys Trp Lys Cys Tyr His Tyr
      165          170          175
Pro Thr Asp Glu Thr Gln Ser
      180

```

<210> 383

<211> 179

<212> PRT

<213> human metapneumo virus

<400> 383

```

Met Ile Thr Leu Asp Val Ile Lys Ser Asp Gly Ser Ser Lys Thr Cys
 1           5           10           15
Thr His Leu Lys Lys Ile Ile Lys Asp His Ser Gly Lys Val Leu Ile
      20           25           30
Ala Leu Lys Leu Ile Leu Ala Leu Leu Thr Phe Phe Thr Ile Thr Ile
      35           40           45
Thr Ile Asn Tyr Ile Lys Val Glu Asn Asn Leu Gln Ile Cys Gln Ser
 50           55           60
Lys Thr Glu Ser Asp Lys Glu Asp Ser Pro Ser Asn Thr Thr Ser Val
65           70           75           80
Thr Thr Lys Thr Thr Leu Asp His Asp Ile Thr Gln Tyr Phe Lys Arg
      85           90           95
Leu Ile Gln Arg Tyr Thr Asp Ser Val Ile Asn Lys Asp Thr Cys Trp
      100          105          110
Lys Ile Ser Arg Asn Gln Cys Thr Asn Ile Thr Thr Tyr Lys Phe Leu
      115          120          125
Cys Phe Lys Pro Glu Asp Ser Lys Ile Asn Ser Cys Asp Arg Leu Thr
130          135          140
Asp Leu Cys Arg Asn Lys Ser Lys Ser Ala Ala Glu Ala Tyr His Thr
145          150          155          160
Val Glu Cys His Cys Ile Tyr Thr Ile Glu Trp Lys Cys Tyr His His
      165          170          175
Pro Ile Asp

```

<210> 384

<211> 177
 <212> PRT
 <213> human metapneumo virus

<400> 384
 Met Lys Thr Leu Asp Val Ile Lys Ser Asp Gly Ser Ser Glu Thr Cys
 1 5 10 15
 Asn Gln Leu Lys Lys Ile Ile Lys Lys His Ser Gly Lys Val Leu Ile
 20 25 30
 Ala Leu Lys Leu Ile Leu Ala Leu Leu Thr Phe Phe Thr Ala Thr Ile
 35 40 45
 Thr Val Asn Tyr Ile Lys Val Glu Asn Asn Leu Gln Ala Cys Gln Pro
 50 55 60
 Lys Asn Glu Ser Asp Lys Lys Val Thr Lys Pro Asn Thr Thr Ser Thr
 65 70 75 80
 Thr Ile Arg Pro Thr Pro Asp Pro Thr Val Val His His Leu Lys Arg
 85 90 95
 Leu Ile Gln Arg His Thr Asn Ser Val Thr Lys Asp Ser Asp Thr Cys
 100 105 110
 Trp Arg Ile His Lys Asn Gln Arg Thr Asn Ile Lys Ile Tyr Lys Phe
 115 120 125
 Leu Cys Ser Gly Phe Thr Asn Ser Lys Gly Thr Asp Cys Glu Glu Pro
 130 135 140
 Thr Ala Leu Cys Asp Lys Lys Leu Lys Thr Ile Val Glu Lys His Arg
 145 150 155 160
 Lys Ala Glu Cys His Cys Leu His Thr Thr Glu Trp Gly Cys Leu His
 165 170 175
 Pro

<210> 385
 <211> 177
 <212> PRT
 <213> human metapneumo virus

<400> 385
 Met Lys Thr Leu Asp Val Ile Lys Ser Asp Gly Ser Ser Glu Thr Cys
 1 5 10 15
 Asn Gln Leu Lys Lys Ile Ile Lys Lys His Ser Gly Lys Leu Leu Ile
 20 25 30
 Ala Leu Lys Leu Ile Leu Ala Leu Leu Thr Phe Phe Thr Val Thr Ile
 35 40 45
 Thr Val Asn Tyr Ile Lys Val Glu Asn Asn Leu Gln Ala Cys Gln Leu
 50 55 60
 Lys Asn Glu Ser Asp Lys Lys Asp Thr Lys Leu Asn Thr Thr Ser Thr
 65 70 75 80
 Thr Ile Arg Pro Ile Pro Asp Leu Asn Ala Val Gln Tyr Leu Lys Arg
 85 90 95
 Leu Ile Gln Lys His Thr Asn Phe Val Ile Lys Asp Arg Asp Thr Cys
 100 105 110
 Trp Arg Ile His Thr Asn Gln Cys Thr Asn Ile Lys Ile Tyr Lys Phe
 115 120 125
 Leu Cys Phe Gly Phe Met Asn Ser Thr Asn Thr Asp Cys Glu Glu Leu
 130 135 140
 Thr Val Leu Cys Asp Lys Lys Ser Lys Thr Met Thr Glu Lys His Arg
 145 150 155 160
 Lys Ala Glu Cys His Cys Leu His Thr Thr Glu Trp Trp Cys Tyr Tyr
 165 170 175
 Leu

<210> 386
 <211> 552
 <212> DNA
 <213> human metapneumo virus

<400> 386
 atgataacat tagatgtcat taaaagtgat ggggtcttcaa aaacatgtac tcacctcaaa 60
 aaaataatta aagaccactc tggtaaagtg cttattgtac ttaagttaat attagcttta 120
 ctaacatttc tcacagtaac aatcaccatc aattatataa aagtggaaaa caatctgcaa 180
 atatgccagt caaaaactga atcagacaaa aaggactcat catcaaatac cacatcagtc 240
 acaaccaaga ctactctaaa tcatgatata acacagtatt ttaaaaagttt gattcaaagg 300
 tatacaaact ctgcaataaa cagtgcacac tgctggaaaa taaacagaaa tcaatgcaca 360
 aatataacaa catacaaatt tttatgtttt aaatctgaag acacaaaaac caacaattgt 420
 gataaactga cagatttatg cagaaacaaa caaaaccag cagttggagt gtatcacata 480
 gtagaatgcc attgtatata cacagttaaa tggaagtgtc atcattaccc aaccgatgaa 540
 acccaatcct aa 552

<210> 387
 <211> 540
 <212> DNA
 <213> human metapneumo virus

<400> 387
 atgataacat tagatgtcat taaaagtgat ggggtcttcaa aaacatgtac tcacctcaaa 60
 aaaataatca aagaccattc tggtaaagtg cttattgcac ttaagttaat attagcttta 120
 ctaacatttt tcacaataac aatcactata aattacataa aagtagaaaa caatctacaa 180
 atatgccagt caaaaactga atcagacaaa gaagactcac catcaaatac cacatccgtc 240
 acaaccaaga ctactctaga ccatgatata acacagtatt ttaaaaagatt aattcaaagg 300
 tatacagatt ctgtgataaa caaggacaca tgctggaaaa taagcagaaa tcaatgcaca 360
 aatataacaa catataaatt tttatgtttt aaacctgagg actcaaaaat caacagttgt 420
 gatagactga cagatctatg cagaaacaaa tcaaaatcag cagctgaagc atatcatata 480
 gtagaatgcc attgcatata cacaattgag tggaagtgtc atcaccaccc aatagattaa 540

<210> 388
 <211> 534
 <212> DNA
 <213> human metapneumo virus

<400> 388
 atgaaaacat tagatgtcat aaaaagtgat ggatcctcag aaacgtgtaa tcaactcaaa 60
 aaaataataa aaaaacactc aggtaaagtg cttattgcac taaaactgat attggcctta 120
 ctgacatttt tcacagcaac aatcactgtc aactatataa aagtagaaaa caatttgca 180
 gcatgtcaac caaaaaatga atcagacaaa aaggtcacaa agccaaatac cacatcaaca 240
 acaatcagac ccacaccoga tccaactgta gtacatcatt tgaaaaggct gattcagaga 300
 cacaccaact ctgtcacaaa agacagcgat acttggtgga gaatacacaa gaatcaacgt 360
 acaaatataa aaatatacaa gttcttatgc tctgggttca caaattcaaa aggtacagat 420
 tgtgaggaac caacagccct atgcgacaaa aagttaaaaa ccatagtaga aaaacataga 480
 aaagcagaat gtcactgtct acatacaacc gagtgggggt gccttcatcc ctaa 534

<210> 389
 <211> 534
 <212> DNA
 <213> human metapneumo virus

<400> 389
 atgaaaacat tagatgtcat aaaaagtgat ggatcctcag aaacatgtaa tcaactcaaa 60
 aaaataataa aaaaacactc aggtaaattg cttattgcat taaaactgat attggcctta 120
 ttgacgtttt tcacagtaac aattactgtt aactatataa aagtagaaaa caatttgca 180

```

gcattgtcaat taaaaaatga atcagacaaa aaggacacaa agctaaatac cacatcaaca 240
acaatcagac ccatttcctga tctaaatgca gtacagtact tgaaaaggct gattcagaaa 300
cacaccaact ttgtcataaa agacagagat acctgttgga gaatacacac gaatcaatgc 360
acaaatataa aaatatataa gttcttatgt ttcgggttta tgaattcaac aaatacagac 420
tgtgaagaac taacagtttt atgtgataaa aagtcaaaaa ccatgacaga aaaacatagg 480
aaagcagagt gtcactgtct acatacaacc gagtggtggt gttattatct ttaa 534

```

<210> 390
 <211> 298
 <212> PRT
 <213> Human respiratory syncytial virus

<220>
 <223> attachment glycoprotein of Human respiratory syncytial virus

```

<400> 390
Met Ser Lys Thr Lys Asp Gln Arg Thr Ala Lys Thr Leu Glu Arg Thr
  1           5           10          15
Trp Asp Thr Leu Asn His Leu Leu Phe Ile Ser Ser Cys Leu Tyr Lys
      20          25          30
Leu Asn Leu Lys Ser Ile Ala Gln Ile Thr Leu Ser Ile Leu Ala Met
      35          40          45
Ile Ile Ser Thr Ser Leu Ile Ile Ala Ala Ile Ile Phe Ile Ala Ser
      50          55          60
Ala Asn His Lys Val Thr Leu Thr Thr Ala Ile Ile Gln Asp Ala Thr
      65          70          75          80
Asn Gln Ile Lys Asn Thr Thr Pro Thr Tyr Leu Thr Gln Asn Pro Gln
      85          90          95
Leu Gly Ile Ser Phe Ser Asn Leu Ser Glu Thr Thr Ser Gln Pro Ile
      100         105         110
Thr Ile Leu Ala Ser Thr Thr Pro Ser Ala Glu Ser Thr Pro Gln Ser
      115         120         125
Thr Thr Val Lys Thr Lys Asn Thr Thr Thr Thr Gln Ile Gln Pro Ser
      130         135         140
Lys Ser Thr Thr Lys Gln Arg Gln Asn Lys Pro Gln Asn Lys Pro Asn
      145         150         155         160
Asn Asp Phe His Phe Glu Val Phe Asn Phe Val Pro Cys Ser Ile Cys
      165         170         175
Ser Asn Asn Pro Thr Cys Trp Ala Ile Cys Lys Arg Ile Pro Asn Lys
      180         185         190
Lys Pro Gly Lys Lys Thr Thr Thr Lys Pro Thr Lys Lys Pro Thr Ile
      195         200         205
Lys Thr Thr Lys Lys Asp Leu Lys Pro Gln Thr Thr Lys Ser Lys Glu
      210         215         220
Val Leu Thr Thr Lys Pro Thr Glu Lys Pro Thr Ile Asn Thr Thr Lys
      225         230         235         240
Thr Asn Ile Arg Thr Thr Leu Leu Ile Ser Asn Thr Thr Gly Asn Pro
      245         250         255
Glu His Thr Ser Gln Lys Glu Thr Leu His Ser Thr Thr Ser Glu Gly
      260         265         270
Asn Pro Ser Pro Ser Gln Val Tyr Thr Thr Ser Glu Tyr Leu Ser Gln
      275         280         285
Ser Leu Ser Pro Ser Asn Thr Thr Tyr Tyr
      290         295

```

<210> 391
 <211> 574
 <212> PRT
 <213> Human respiratory syncytial virus

<220>

<223> fusion glycoprotein of Human respiratory syncytial virus

<400> 391

```

Met Glu Leu Pro Ile Leu Lys Ala Asn Ala Ile Thr Thr Ile Leu Ala
 1           5           10           15
Ala Val Thr Leu Cys Phe Val Ser Ser Gln Asn Ile Thr Glu Glu Phe
          20           25           30
Tyr Gln Ser Thr Cys Ser Ala Val Ser Lys Gly Tyr Leu Ser Ala Leu
          35           40           45
Arg Thr Gly Trp Tyr Thr Ser Val Ile Thr Ile Glu Leu Ser Asn Ile
          50           55           60
Lys Glu Asn Lys Cys Asn Gly Thr Asp Ala Lys Val Lys Leu Ile Lys
65           70           75           80
Gln Glu Leu Asp Lys Tyr Lys Asn Ala Val Thr Glu Leu Gln Leu Leu
          85           90           95
Met Gln Ser Thr Pro Ala Ala Asn Asn Arg Ala Arg Arg Glu Leu Pro
          100          105          110
Arg Phe Met Asn Tyr Thr Leu Asn Asn Thr Lys Asn Thr Asn Val Thr
          115          120          125
Leu Ser Lys Lys Arg Lys Arg Arg Phe Leu Gly Phe Leu Leu Gly Val
          130          135          140
Gly Ser Ala Ile Ala Ser Gly Ile Ala Val Ser Lys Val Leu His Leu
145          150          155          160
Glu Gly Glu Val Asn Lys Ile Lys Ser Ala Leu Leu Ser Thr Asn Lys
          165          170          175
Ala Val Val Ser Leu Ser Asn Gly Val Ser Val Leu Thr Ser Lys Val
          180          185          190
Leu Asp Leu Lys Asn Tyr Ile Asp Lys Gln Leu Leu Pro Ile Val Asn
          195          200          205
Lys Gln Ser Cys Ser Ile Ser Asn Ile Glu Thr Val Ile Glu Phe Gln
          210          215          220
Gln Lys Asn Asn Arg Leu Leu Glu Ile Thr Arg Glu Phe Ser Val Asn
225          230          235          240
Ala Gly Val Thr Thr Pro Val Ser Thr Tyr Met Leu Thr Asn Ser Glu
          245          250          255
Leu Leu Ser Leu Ile Asn Asp Met Pro Ile Thr Asn Asp Gln Lys Lys
          260          265          270
Leu Met Ser Asn Asn Val Gln Ile Val Arg Gln Gln Ser Tyr Ser Ile
          275          280          285
Met Ser Ile Ile Lys Glu Glu Val Leu Ala Tyr Val Val Gln Leu Pro
          290          295          300
Leu Tyr Gly Val Ile Asp Thr Pro Cys Trp Lys Leu His Thr Ser Pro
305          310          315          320
Leu Cys Thr Thr Asn Thr Lys Glu Gly Ser Asn Ile Cys Leu Thr Arg
          325          330          335
Thr Asp Arg Gly Trp Tyr Cys Asp Asn Ala Gly Ser Val Ser Phe Phe
          340          345          350
Pro Gln Ala Glu Thr Cys Lys Val Gln Ser Asn Arg Val Phe Cys Asp
          355          360          365
Thr Met Asn Ser Leu Thr Leu Pro Ser Glu Val Asn Leu Cys Asn Val
          370          375          380
Asp Ile Phe Asn Pro Lys Tyr Asp Cys Lys Ile Met Thr Ser Lys Thr
385          390          395          400
Asp Val Ser Ser Ser Val Ile Thr Ser Leu Gly Ala Ile Val Ser Cys
          405          410          415
Tyr Gly Lys Thr Lys Cys Thr Ala Ser Asn Lys Asn Arg Gly Ile Ile
          420          425          430
Lys Thr Phe Ser Asn Gly Cys Asp Tyr Val Ser Asn Lys Gly Val Asp
          435          440          445

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Thr Val Ser Val Gly Asn Thr Leu Tyr Tyr Val Asn Lys Gln Glu Gly
  450                      455                      460
Lys Asn Leu Tyr Val Lys Gly Glu Pro Ile Ile Asn Phe Tyr Asp Pro
465                      470                      475                      480
Leu Val Phe Pro Ser Asp Glu Phe Asp Ala Ser Ile Ser Gln Val Asn
                      485                      490                      495
Glu Lys Ile Asn Gln Ser Leu Ala Phe Ile Arg Lys Ser Asp Glu Leu
                      500                      505                      510
Leu His Asn Val Asn Ala Gly Lys Ser Thr Thr Asn Ile Met Ile Thr
                      515                      520                      525
Thr Ile Ile Ile Val Ile Ile Val Ile Leu Leu Ser Leu Ile Ala Val
  530                      535                      540
Gly Leu Leu Leu Tyr Cys Lys Ala Arg Ser Thr Pro Val Thr Leu Ser
545                      550                      555                      560
Lys Asp Gln Leu Ser Gly Ile Asn Asn Ile Ala Phe Ser Ser
                      565                      570

```

<210> 392

<211> 64

<212> PRT

<213> Human respiratory syncytial virus

<220>

<223> small hydrophobic protein of Human respiratory syncytial virus

<400> 392

```

Met Glu Asn Thr Ser Ile Thr Ile Glu Phe Ser Ser Lys Phe Trp Pro
  1                      5                      10                      15
Tyr Phe Thr Leu Ile His Met Ile Thr Thr Ile Ile Ser Leu Leu Ile
                      20                      25                      30
Ile Ile Ser Ile Met Ile Ala Ile Leu Asn Lys Leu Cys Glu Tyr Asn
                      35                      40                      45
Ala Phe His Asn Lys Thr Phe Glu Leu Pro Arg Ala Arg Ile Asn Thr
  50                      55                      60

```

<210> 393

<211> 2165

<212> PRT

<213> Human respiratory syncytial virus (strain A2)

<220>

<223> RNA polymerase beta subunit (Large structural protein) (L protein)
of Human respiratory syncytial virus

<400> 393

```

Met Asp Pro Ile Ile Asn Gly Asn Ser Ala Asn Val Tyr Leu Thr Asp
  1                      5                      10                      15
Ser Tyr Leu Lys Gly Val Ile Ser Phe Ser Glu Cys Asn Ala Leu Gly
                      20                      25                      30
Ser Tyr Ile Phe Asn Gly Pro Tyr Leu Lys Asn Asp Tyr Thr Asn Leu
                      35                      40                      45
Ile Ser Arg Gln Asn Pro Leu Ile Glu His Met Asn Leu Lys Lys Leu
  50                      55                      60
Asn Ile Thr Gln Ser Leu Ile Ser Lys Tyr His Lys Gly Glu Ile Lys
65                      70                      75                      80
Leu Glu Glu Pro Thr Tyr Phe Gln Ser Leu Leu Met Thr Tyr Lys Ser
                      85                      90                      95
Met Thr Ser Ser Glu Gln Ile Ala Thr Thr Asn Leu Leu Lys Lys Ile
                      100                      105                      110

```


Ile Arg Arg Ala Ile Glu Ile Ser Asp Val Lys Val Tyr Ala Ile Leu
 115 120 125
 Asn Lys Leu Gly Leu Lys Glu Lys Asp Lys Ile Lys Ser Asn Asn Gly
 130 135 140
 Gln Asp Glu Asp Asn Ser Val Ile Thr Thr Ile Ile Lys Asp Asp Ile
 145 150 155 160
 Leu Ser Ala Val Lys Asp Asn Gln Ser His Leu Lys Ala Asp Lys Asn
 165 170 175
 His Ser Thr Lys Gln Lys Asp Thr Ile Lys Thr Thr Leu Leu Lys Lys
 180 185 190
 Leu Met Cys Ser Met Gln His Pro Pro Ser Trp Leu Ile His Trp Phe
 195 200 205
 Asn Leu Tyr Thr Lys Leu Asn Asn Ile Leu Thr Gln Tyr Arg Ser Asn
 210 215 220
 Glu Val Lys Asn His Gly Phe Thr Leu Ile Asp Asn Gln Thr Leu Ser
 225 230 235 240
 Gly Phe Gln Phe Ile Leu Asn Gln Tyr Gly Cys Ile Val Tyr His Lys
 245 250 255
 Glu Leu Lys Arg Ile Thr Val Thr Thr Tyr Asn Gln Phe Leu Thr Trp
 260 265 270
 Lys Asp Ile Ser Leu Ser Arg Leu Asn Val Cys Leu Ile Thr Trp Ile
 275 280 285
 Ser Asn Cys Leu Asn Thr Leu Asn Lys Ser Leu Gly Leu Arg Cys Gly
 290 295 300
 Phe Asn Asn Val Ile Leu Thr Gln Leu Phe Leu Tyr Gly Asp Cys Ile
 305 310 315 320
 Leu Lys Leu Phe His Asn Glu Gly Phe Tyr Ile Ile Lys Glu Val Glu
 325 330 335
 Gly Phe Ile Met Ser Leu Ile Leu Asn Ile Thr Glu Glu Asp Gln Phe
 340 345 350
 Arg Lys Arg Phe Tyr Asn Ser Met Leu Asn Asn Ile Thr Asp Ala Ala
 355 360 365
 Asn Lys Ala Gln Lys Asn Leu Leu Ser Arg Val Cys His Thr Leu Leu
 370 375 380
 Asp Lys Thr Val Ser Asp Asn Ile Ile Asn Gly Arg Trp Ile Ile Leu
 385 390 395 400
 Leu Ser Lys Phe Leu Lys Leu Ile Lys Leu Ala Gly Asp Asn Asn Leu
 405 410 415
 Asn Asn Leu Ser Glu Leu Tyr Phe Leu Phe Arg Ile Phe Gly His Pro
 420 425 430
 Met Val Asp Glu Arg Gln Ala Met Asp Ala Val Lys Ile Asn Cys Asn
 435 440 445
 Glu Thr Lys Phe Tyr Leu Leu Ser Ser Leu Ser Met Leu Arg Gly Ala
 450 455 460
 Phe Ile Tyr Arg Ile Ile Lys Gly Phe Val Asn Asn Tyr Asn Arg Trp
 465 470 475 480
 Pro Thr Leu Arg Asn Ala Ile Val Leu Pro Leu Arg Trp Leu Thr Tyr
 485 490 495
 Tyr Lys Leu Asn Thr Tyr Pro Ser Leu Leu Glu Leu Thr Glu Arg Asp
 500 505 510
 Leu Ile Val Leu Ser Gly Leu Arg Phe Tyr Arg Glu Phe Arg Leu Pro
 515 520 525
 Lys Lys Val Asp Leu Glu Met Ile Ile Asn Asp Lys Ala Ile Ser Pro
 530 535 540
 Pro Lys Asn Leu Ile Trp Thr Ser Phe Pro Arg Asn Tyr Met Pro Ser
 545 550 555 560
 His Ile Gln Asn Tyr Ile Glu His Glu Lys Leu Lys Phe Ser Glu Ser
 565 570 575
 Asp Lys Ser Arg Arg Val Leu Glu Tyr Tyr Leu Arg Asp Asn Lys Phe
 580 585 590
 Asn Glu Cys Asp Leu Tyr Asn Cys Val Val Asn Gln Ser Tyr Leu Asn

	595		600		605										
Asn	Pro	Asn	His	Val	Val	Ser	Leu	Thr	Gly	Lys	Glu	Arg	Glu	Leu	Ser
	610						615					620			
Val	Gly	Arg	Met	Phe	Ala	Met	Gln	Pro	Gly	Met	Phe	Arg	Gln	Val	Gln
625					630					635					640
Ile	Leu	Ala	Glu	Lys	Met	Ile	Ala	Glu	Asn	Ile	Leu	Gln	Phe	Phe	Pro
				645					650					655	
Glu	Ser	Leu	Thr	Arg	Tyr	Gly	Asp	Leu	Glu	Leu	Gln	Lys	Ile	Leu	Glu
			660					665					670		
Leu	Lys	Ala	Gly	Ile	Ser	Asn	Lys	Ser	Asn	Arg	Tyr	Asn	Asp	Asn	Tyr
		675					680					685			
Asn	Asn	Tyr	Ile	Ser	Lys	Cys	Ser	Ile	Ile	Thr	Asp	Leu	Ser	Lys	Phe
	690					695					700				
Asn	Gln	Ala	Phe	Arg	Tyr	Glu	Thr	Ser	Cys	Ile	Cys	Ser	Asp	Val	Leu
705					710					715					720
Asp	Glu	Leu	His	Gly	Val	Gln	Ser	Leu	Phe	Ser	Trp	Leu	His	Leu	Thr
				725					730					735	
Ile	Pro	His	Val	Thr	Ile	Ile	Cys	Thr	Tyr	Arg	His	Ala	Pro	Pro	Tyr
			740					745					750		
Ile	Gly	Asp	His	Ile	Val	Asp	Leu	Asn	Asn	Val	Asp	Glu	Gln	Ser	Gly
		755					760					765			
Leu	Tyr	Arg	Tyr	His	Met	Gly	Gly	Ile	Glu	Gly	Trp	Cys	Gln	Lys	Leu
	770					775					780				
Trp	Thr	Ile	Glu	Ala	Ile	Ser	Leu	Leu	Asp	Leu	Ile	Ser	Leu	Lys	Gly
785					790					795					800
Lys	Phe	Ser	Ile	Thr	Ala	Leu	Ile	Asn	Gly	Asp	Asn	Gln	Ser	Ile	Asp
				805					810					815	
Ile	Ser	Lys	Pro	Ile	Arg	Leu	Met	Glu	Gly	Gln	Thr	His	Ala	Gln	Ala
			820					825					830		
Asp	Tyr	Leu	Leu	Ala	Leu	Asn	Ser	Leu	Lys	Leu	Leu	Tyr	Lys	Glu	Tyr
		835					840					845			
Ala	Gly	Ile	Gly	His	Lys	Leu	Lys	Gly	Thr	Glu	Thr	Tyr	Ile	Ser	Arg
	850					855					860				
Asp	Met	Gln	Phe	Met	Ser	Lys	Thr	Ile	Gln	His	Asn	Gly	Val	Tyr	Tyr
865					870					875					880
Pro	Ala	Ser	Ile	Lys	Lys	Val	Leu	Arg	Val	Gly	Pro	Trp	Ile	Asn	Thr
				885					890					895	
Ile	Leu	Asp	Asp	Phe	Lys	Val	Ser	Leu	Glu	Ser	Ile	Gly	Ser	Leu	Thr
		900						905					910		
Gln	Glu	Leu	Glu	Tyr	Arg	Gly	Glu	Ser	Leu	Leu	Cys	Ser	Leu	Ile	Phe
		915					920					925			
Arg	Asn	Val	Trp	Leu	Tyr	Asn	Gln	Ile	Ala	Leu	Gln	Leu	Lys	Asn	His
	930					935						940			
Ala	Leu	Cys	Asn	Asn	Lys	Leu	Tyr	Leu	Asp	Ile	Leu	Lys	Val	Leu	Lys
945					950					955					960
His	Leu	Lys	Thr	Phe	Phe	Asn	Leu	Asp	Asn	Ile	Asp	Thr	Ala	Leu	Thr
			965						970					975	
Leu	Tyr	Met	Asn	Leu	Pro	Met	Leu	Phe	Gly	Gly	Gly	Asp	Pro	Asn	Leu
		980						985					990		
Leu	Tyr	Arg	Ser	Phe	Tyr	Arg	Arg	Thr	Pro	Asp	Phe	Leu	Thr	Glu	Ala
		995					1000						1005		
Ile	Val	His	Ser	Val	Phe	Ile	Leu	Ser	Tyr	Tyr	Thr	Asn	His	Asp	Leu
	1010						1015						1020		
Lys	Asp	Lys	Leu	Gln	Asp	Leu	Ser	Asp	Asp	Arg	Leu	Asn	Lys	Phe	Leu
1025					1030					1035					1040
Thr	Cys	Ile	Ile	Thr	Phe	Asp	Lys	Asn	Pro	Asn	Ala	Glu	Phe	Val	Thr
				1045					1050					1055	
Leu	Met	Arg	Asp	Pro	Gln	Ala	Leu	Gly	Ser	Glu	Arg	Gln	Ala	Lys	Ile
			1060					1065					1070		
Thr	Ser	Glu	Ile	Asn	Arg	Leu	Ala	Val	Thr	Glu	Val	Leu	Ser	Thr	Ala
		1075					1080						1085		

Pro Asn Lys Ile Phe Ser Lys Ser Ala Gln His Tyr Thr Thr Thr Glu
 1090 1095 1100
 Ile Asp Leu Asn Asp Ile Met Gln Asn Ile Glu Pro Thr Tyr Pro His
 1105 1110 1115 1120
 Gly Leu Arg Val Val Tyr Glu Ser Leu Pro Phe Tyr Lys Ala Glu Lys
 1125 1130 1135
 Ile Val Asn Leu Ile Ser Gly Thr Lys Ser Ile Thr Asn Ile Leu Glu
 1140 1145 1150
 Lys Thr Ser Ala Ile Asp Leu Thr Asp Ile Asp Arg Ala Thr Glu Met
 1155 1160 1165
 Met Arg Lys Asn Ile Thr Leu Leu Ile Arg Ile Leu Pro Leu Asp Cys
 1170 1175 1180
 Asn Arg Asp Lys Arg Glu Ile Leu Ser Met Glu Asn Leu Ser Ile Thr
 1185 1190 1195 1200
 Glu Leu Ser Lys Tyr Val Arg Glu Arg Ser Trp Ser Leu Ser Asn Ile
 1205 1210 1215
 Val Gly Val Thr Ser Pro Ser Ile Met Tyr Thr Met Asp Ile Lys Tyr
 1220 1225 1230
 Thr Thr Ser Thr Ile Ser Ser Gly Ile Ile Ile Glu Lys Tyr Asn Val
 1235 1240 1245
 Asn Ser Leu Thr Arg Gly Glu Arg Gly Pro Thr Lys Pro Trp Val Gly
 1250 1255 1260
 Ser Ser Thr Gln Glu Lys Lys Thr Met Pro Val Tyr Asn Arg Gln Val
 1265 1270 1275 1280
 Leu Thr Lys Lys Gln Arg Asp Gln Ile Asp Leu Leu Ala Lys Leu Asp
 1285 1290 1295
 Trp Val Tyr Ala Ser Ile Asp Asn Lys Asp Glu Phe Met Glu Glu Leu
 1300 1305 1310
 Ser Ile Gly Thr Leu Gly Leu Thr Tyr Glu Lys Ala Lys Lys Leu Phe
 1315 1320 1325
 Pro Gln Tyr Leu Ser Val Asn Tyr Leu His Arg Leu Thr Val Ser Ser
 1330 1335 1340
 Arg Pro Cys Glu Phe Pro Ala Ser Ile Pro Ala Tyr Arg Thr Thr Asn
 1345 1350 1355 1360
 Tyr His Phe Asp Thr Ser Pro Ile Asn Arg Ile Leu Thr Glu Lys Tyr
 1365 1370 1375
 Gly Asp Glu Asp Ile Asp Ile Val Phe Gln Asn Cys Ile Ser Phe Gly
 1380 1385 1390
 Leu Ser Leu Met Ser Val Val Glu Gln Phe Thr Asn Val Cys Pro Asn
 1395 1400 1405
 Arg Ile Ile Leu Ile Pro Lys Leu Asn Glu Ile His Leu Met Lys Pro
 1410 1415 1420
 Pro Ile Phe Thr Gly Asp Val Asp Ile His Lys Leu Lys Gln Val Ile
 1425 1430 1435 1440
 Gln Lys Gln His Met Phe Leu Pro Asp Lys Ile Ser Leu Thr Gln Tyr
 1445 1450 1455
 Val Glu Leu Phe Leu Ser Asn Lys Thr Leu Lys Ser Gly Ser His Val
 1460 1465 1470
 Asn Ser Asn Leu Ile Leu Ala His Lys Ile Ser Asp Tyr Phe His Asn
 1475 1480 1485
 Thr Tyr Ile Leu Ser Thr Asn Leu Ala Gly His Trp Ile Leu Ile Ile
 1490 1495 1500
 Gln Leu Met Lys Asp Ser Lys Gly Ile Phe Glu Lys Asp Trp Gly Glu
 1505 1510 1515 1520
 Gly Tyr Ile Thr Asp His Met Phe Ile Asn Leu Lys Val Phe Phe Asn
 1525 1530 1535
 Ala Tyr Lys Thr Tyr Leu Leu Cys Phe His Lys Gly Tyr Gly Lys Ala
 1540 1545 1550
 Lys Leu Glu Cys Asp Met Asn Thr Ser Asp Leu Leu Cys Val Leu Glu
 1555 1560 1565
 Leu Ile Asp Ser Ser Tyr Trp Lys Ser Met Ser Lys Val Phe Leu Glu

1570	1575	1580
Gln Lys Val Ile Lys Tyr Ile Leu Ser Gln Asp Ala Ser Leu His Arg		
1585	1590	1595
Val Lys Gly Cys His Ser Phe Lys Leu Trp Phe Leu Lys Arg Leu Asn		1600
	1605	1610
Val Ala Glu Phe Thr Val Cys Pro Trp Val Val Asn Ile Asp Tyr His		1615
	1620	1625
Pro Thr His Met Lys Ala Ile Leu Thr Tyr Ile Asp Leu Val Arg Met		1630
	1635	1640
Gly Leu Ile Asn Ile Asp Arg Ile His Ile Lys Asn Lys His Lys Phe		1645
	1650	1655
Asn Asp Glu Phe Tyr Thr Ser Asn Leu Phe Tyr Ile Asn Tyr Asn Phe		1660
	1665	1670
Ser Asp Asn Thr His Leu Leu Thr Lys His Ile Arg Ile Ala Asn Ser		1675
	1685	1690
Glu Leu Glu Asn Asn Tyr Asn Lys Leu Tyr His Pro Thr Pro Glu Thr		1695
	1700	1705
Leu Glu Asn Ile Leu Ala Asn Pro Ile Lys Ser Asn Asp Lys Lys Thr		1710
	1715	1720
Leu Asn Asp Tyr Cys Ile Gly Lys Asn Val Asp Ser Ile Met Leu Pro		1725
	1730	1735
Leu Leu Ser Asn Lys Lys Leu Ile Lys Ser Ser Ala Met Ile Arg Thr		1740
	1745	1750
Asn Tyr Ser Lys Gln Asp Leu Tyr Asn Leu Phe Pro Met Val Val Ile		1755
	1765	1770
Asp Arg Ile Ile Asp His Ser Gly Asn Thr Ala Lys Ser Asn Gln Leu		1775
	1780	1785
Tyr Thr Thr Thr Ser His Gln Ile Ser Leu Val His Asn Ser Thr Ser		1790
	1795	1800
Leu Tyr Cys Met Leu Pro Trp His His Ile Asn Arg Phe Asn Phe Val		1805
	1810	1815
Phe Ser Ser Thr Gly Cys Lys Ile Ser Ile Glu Tyr Ile Leu Lys Asp		1820
	1825	1830
Leu Lys Ile Lys Asp Pro Asn Cys Ile Ala Phe Ile Gly Glu Gly Ala		1835
	1845	1850
Gly Asn Leu Leu Arg Thr Val Val Glu Leu His Pro Asp Ile Arg		1855
	1860	1865
Tyr Ile Tyr Arg Ser Leu Lys Asp Cys Asn Asp His Ser Leu Pro Ile		1870
	1875	1880
Glu Phe Leu Arg Leu Tyr Asn Gly His Ile Asn Ile Asp Tyr Gly Glu		1885
	1890	1895
Asn Leu Thr Ile Pro Ala Thr Asp Ala Thr Asn Asn Ile His Trp Ser		1900
	1905	1910
Tyr Leu His Ile Lys Phe Ala Glu Pro Ile Ser Leu Phe Val Cys Asp		1915
	1925	1930
Ala Glu Leu Ser Val Thr Val Asn Trp Ser Lys Ile Ile Ile Glu Trp		1935
	1940	1945
Ser Lys His Val Arg Lys Cys Lys Tyr Cys Ser Ser Val Asn Lys Cys		1950
	1955	1960
Met Leu Ile Val Lys Tyr His Ala Gln Asp Asp Ile Asp Phe Lys Leu		1965
	1970	1975
Asp Asn Ile Thr Ile Leu Lys Thr Tyr Val Cys Leu Gly Ser Lys Leu		1980
	1985	1990
Lys Gly Ser Glu Val Tyr Leu Val Leu Thr Ile Gly Pro Ala Asn Ile		1995
	2005	2010
Phe Pro Val Phe Asn Val Val Gln Asn Ala Lys Leu Ile Leu Ser Arg		2015
	2020	2025
Thr Lys Asn Phe Ile Met Pro Lys Lys Ala Asp Lys Glu Ser Ile Asp		2030
	2035	2040
Ala Asn Ile Lys Ser Leu Ile Pro Phe Leu Cys Tyr Pro Ile Thr Lys		2045
	2050	2055
		2060

Lys Gly Ile Asn Thr Ala Leu Ser Lys Leu Lys Ser Val Val Ser Gly
 2065 2070 2075 2080
 Asp Ile Leu Ser Tyr Ser Ile Ala Gly Arg Asn Glu Val Phe Ser Asn
 2085 2090 2095
 Lys Leu Ile Asn His Lys His Met Asn Ile Leu Lys Trp Phe Asn His
 2100 2105 2110
 Val Leu Asn Phe Arg Ser Thr Glu Leu Asn Tyr Asn His Leu Tyr Met
 2115 2120 2125
 Val Glu Ser Thr Tyr Pro Tyr Leu Ser Glu Leu Leu Asn Ser Leu Thr
 2130 2135 2140
 Thr Asn Glu Leu Lys Lys Leu Ile Lys Ile Thr Gly Ser Leu Leu Tyr
 2145 2150 2155 2160
 Asn Phe His Asn Glu
 2165

<210> 394

<211> 241

<212> PRT

<213> Human respiratory syncytial virus

<220>

<223> phosphoprotein P of Human respiratory syncytial virus

<400> 394

Met Glu Lys Phe Ala Pro Glu Phe His Gly Glu Asp Ala Asn Asn Arg
 1 5 10 15
 Ala Thr Lys Phe Leu Glu Ser Ile Lys Gly Lys Phe Thr Ser Pro Lys
 20 25 30
 Asp Pro Lys Lys Lys Asp Ser Ile Ile Ser Val Asn Ser Ile Asp Ile
 35 40 45
 Glu Val Thr Lys Glu Ser Pro Ile Thr Ser Asn Ser Thr Ile Met Asn
 50 55 60
 Pro Thr Asn Glu Thr Asp Asp Thr Val Gly Asn Lys Pro Asn Tyr Gln
 65 70 75 80
 Arg Lys Pro Leu Val Ser Phe Lys Glu Asp Pro Met Leu Ser Asp Asn
 85 90 95
 Pro Phe Ser Lys Leu Tyr Lys Glu Thr Ile Glu Thr Phe Asp Asn Asn
 100 105 110
 Glu Glu Glu Ser Ser Tyr Ser Tyr Glu Glu Ile Asn Asp Gln Thr Asn
 115 120 125
 Asp Asn Ile Thr Ala Arg Leu Asp Arg Ile Asp Glu Lys Leu Ser Glu
 130 135 140
 Ile Leu Gly Met Leu His Thr Leu Val Val Ala Ser Ala Gly Pro Thr
 145 150 155 160
 Ser Ala Arg Asp Gly Ile Arg Asp Ala Met Val Gly Leu Arg Glu Glu
 165 170 175
 Met Ile Glu Lys Ile Arg Thr Glu Ala Leu Met Thr Asn Asn Arg Leu
 180 185 190
 Glu Ala Met Ala Arg Leu Arg Asn Glu Glu Ser Glu Lys Met Ala Lys
 195 200 205
 Asp Thr Ser Asp Glu Val Ser Leu Asn Pro Thr Ser Glu Lys Leu Asn
 210 215 220
 Asn Leu Leu Glu Gly Asn Asp Ser Asp Asp Asp Leu Ser Leu Glu Asp
 225 230 235 240
 Phe

<210> 395

<211> 83

<212> PRT

<213> Human respiratory syncytial virus

<220>

<223> attachment glycoprotein G of Human respiratory syncytial virus

<400> 395

```

Lys Arg Asp Pro Lys Thr Pro Ala Lys Met Leu Asn Lys Glu Thr Thr
 1           5           10           15
Thr Asn Pro Thr Lys Asn Leu Thr Leu Lys Thr Thr Glu Arg Asp Thr
          20           25           30
Ser Thr Ser Gln Ser Thr Val Leu Asp Thr Ser Thr Ser Lys His Ile
          35           40           45
Ile Leu Gln Gln Ser Leu His Ser Thr Thr Pro Glu Asn Thr Pro Asn
          50           55           60
Phe Thr Gln Thr Pro Thr Ala Ser Glu Pro Ser Thr Ser Asn Ser Thr
65           70           75           80
Gln Lys Thr

```

<210> 396

<211> 391

<212> PRT

<213> human respiratory syncytial virus (strain 18537)

<220>

<223> nucleocapsid protein of Human respiratory syncytial virus

<400> 396

```

Met Ala Leu Ser Lys Val Lys Leu Asn Asp Thr Leu Asn Lys Asp Gln
 1           5           10           15
Leu Leu Ser Ser Ser Lys Tyr Thr Ile Gln Arg Ser Thr Gly Asp Asn
          20           25           30
Ile Asp Thr Pro Asn Tyr Asp Val Gln Lys His Leu Asn Lys Leu Cys
          35           40           45
Gly Met Leu Leu Ile Thr Glu Asp Ala Asn His Lys Phe Thr Gly Leu
          50           55           60
Ile Gly Met Leu Tyr Ala Met Ser Arg Leu Gly Arg Glu Asp Thr Ile
65           70           75           80
Lys Ile Leu Lys Asp Ala Gly Tyr His Val Lys Ala Asn Gly Val Asp
          85           90           95
Ile Thr Thr Tyr Arg Gln Asp Ile Asn Gly Lys Glu Met Lys Phe Glu
          100          105          110
Val Leu Thr Leu Ser Ser Leu Thr Ser Glu Ile Gln Val Asn Ile Glu
          115          120          125
Ile Glu Ser Arg Lys Ser Tyr Lys Lys Leu Leu Lys Glu Met Gly Glu
          130          135          140
Val Ala Pro Glu Tyr Arg His Asp Ser Pro Asp Cys Gly Met Ile Ile
145          150          155          160
Leu Cys Ile Ala Ala Leu Val Ile Thr Lys Leu Ala Ala Gly Asp Arg
          165          170          175
Ser Gly Leu Thr Ala Val Ile Arg Arg Ala Asn Asn Val Leu Lys Asn
          180          185          190
Glu Ile Lys Arg Tyr Lys Gly Leu Ile Pro Lys Asp Ile Ala Asn Ser
          195          200          205
Phe Tyr Glu Val Phe Glu Lys His Pro His Leu Ile Asp Val Phe Val
          210          215          220
His Phe Gly Ile Ala Gln Ser Ser Thr Arg Gly Gly Ser Arg Val Glu
225          230          235          240
Gly Ile Phe Ala Gly Leu Phe Met Asn Ala Tyr Gly Ser Gly Gln Val
          245          250          255
Met Leu Arg Trp Gly Val Leu Ala Lys Ser Val Lys Asn Ile Met Leu

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      260      265      270
Gly His Ala Ser Val Gln Ala Glu Met Glu Gln Val Val Glu Val Tyr
      275      280      285
Glu Tyr Ala Gln Lys Leu Gly Gly Glu Ala Gly Phe Tyr His Ile Leu
      290      295      300
Asn Asn Pro Lys Ala Ser Leu Leu Ser Leu Thr Gln Phe Pro Asn Phe
305      310      315      320
Ser Ser Val Val Leu Gly Asn Ala Ala Gly Leu Gly Ile Met Gly Glu
      325      330      335
Tyr Arg Gly Thr Pro Arg Asn Gln Asp Leu Tyr Asp Ala Ala Lys Ala
      340      345      350
Tyr Ala Glu Gln Leu Lys Glu Asn Gly Val Ile Asn Tyr Ser Val Leu
      355      360      365
Asp Leu Thr Ala Glu Glu Leu Glu Ala Ile Lys His Gln Leu Asn Pro
      370      375      380
Lys Glu Asp Asp Val Glu Leu
385      390

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<210> 397

<211> 391

<212> PRT

<213> Human respiratory syncytial virus

<220>

<223> nucleoprotein (N) of Human respiratory syncytial virus

<400> 397

```

Met Ala Leu Ser Lys Val Lys Leu Asn Asp Thr Leu Asn Lys Asp Gln
 1      5      10      15
Leu Leu Ser Ser Ser Lys Tyr Thr Ile Gln Arg Ser Thr Gly Asp Ser
      20      25      30
Ile Asp Thr Pro Asn Tyr Asp Val Gln Lys His Ile Asn Lys Leu Cys
      35      40      45
Gly Met Leu Leu Ile Thr Glu Asp Ala Asn His Lys Phe Thr Gly Leu
      50      55      60
Ile Gly Met Leu Tyr Ala Met Ser Arg Leu Gly Arg Glu Asp Thr Ile
65      70      75      80
Lys Ile Leu Arg Asp Ala Gly Tyr His Val Lys Ala Asn Gly Val Asp
      85      90      95
Val Thr Thr His Arg Gln Asp Ile Asn Gly Lys Glu Met Lys Phe Glu
      100      105      110
Val Leu Thr Leu Ser Ser Leu Thr Thr Glu Ile Gln Ile Asn Ile Glu
      115      120      125
Ile Glu Ser Arg Lys Ser Tyr Lys Lys Met Leu Lys Glu Met Gly Glu
      130      135      140
Val Ala Pro Glu Tyr Arg His Asp Ser Pro Asp Cys Gly Met Ile Ile
145      150      155      160
Leu Cys Ile Ala Ala Leu Val Ile Thr Lys Leu Ala Ala Gly Asp Arg
      165      170      175
Ser Gly Leu Thr Ala Val Ile Arg Arg Ala Asn Asn Val Leu Lys Asn
      180      185      190
Glu Met Lys Arg Tyr Lys Gly Leu Leu Pro Lys Asp Ile Ala Asn Ser
      195      200      205
Phe Tyr Glu Val Phe Glu Lys Tyr Pro His Phe Ile Asp Val Phe Val
      210      215      220
His Phe Gly Ile Ala Gln Ser Ser Thr Arg Gly Gly Ser Arg Val Glu
225      230      235      240
Gly Ile Phe Ala Gly Leu Phe Met Asn Ala Tyr Gly Ala Gly Gln Val
      245      250      255
Met Leu Arg Trp Gly Val Leu Ala Lys Ser Val Lys Asn Ile Met Leu

```

			260				265				270				
Gly	His	Ala	Ser	Val	Gln	Ala	Glu	Met	Glu	Gln	Val	Val	Glu	Val	Tyr
			275				280				285				
Glu	Tyr	Ala	Gln	Lys	Leu	Gly	Gly	Glu	Ala	Gly	Phe	Tyr	His	Ile	Leu
			290				295				300				
Asn	Asn	Pro	Lys	Ala	Ser	Leu	Leu	Ser	Leu	Thr	Gln	Phe	Pro	His	Phe
			305				310				315				
Ser	Ser	Val	Val	Leu	Gly	Asn	Ala	Ala	Gly	Leu	Gly	Ile	Met	Gly	Glu
			325				330				335				
Tyr	Arg	Gly	Thr	Pro	Arg	Asn	Gln	Asp	Leu	Tyr	Asp	Ala	Ala	Lys	Ala
			340				345				350				
Tyr	Ala	Glu	Gln	Leu	Lys	Glu	Asn	Gly	Val	Ile	Asn	Tyr	Ser	Val	Leu
			355				360				365				
Asp	Leu	Thr	Ala	Glu	Glu	Leu	Glu	Ala	Ile	Lys	His	Gln	Leu	Asn	Pro
			370				375				380				
Lys	Asp	Asn	Asp	Val	Glu	Leu									
			385				390								

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<210> 398
<211> 256
<212> PRT
<213> Human respiratory syncytial virus
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<220>
<223>matrix protein of Human respiratory syncytial virus

<400> 398															
Met.	Glu	Thr	Tyr	Val	Asn	Lys	Leu	His	Glu	Gly	Ser	Thr	Tyr	Thr	Ala
1				5					10					15	
Ala	Val	Gln	Tyr	Asn	Val	Leu	Glu	Lys	Asp	Asp	Asp	Pro	Ala	Ser	Leu
			20					25					30		
Thr	Ile	Trp	Val	Pro	Met	Phe	Gln	Ser	Ser	Met	Pro	Ala	Asp	Leu	Leu
		35					40					45			
Ile	Lys	Glu	Leu	Ala	Asn	Val	Asn	Ile	Leu	Val	Lys	Gln	Ile	Ser	Thr
	50				55						60				
Pro	Lys	Gly	Pro	Ser	Leu	Arg	Val	Met	Ile	Asn	Ser	Arg	Ser	Ala	Val
65				70						75					80
Leu	Ala	Gln	Met	Pro	Ser	Lys	Phe	Thr	Ile	Cys	Ala	Asn	Val	Ser	Leu
				85					90					95	
Asp	Glu	Arg	Ser	Lys	Leu	Ala	Tyr	Asp	Val	Thr	Thr	Pro	Cys	Glu	Ile
			100					105					110		
Lys	Ala	Cys	Ser	Leu	Thr	Cys	Leu	Lys	Ser	Lys	Asn	Met	Leu	Thr	Thr
		115					120					125			
Val	Lys	Asp	Leu	Thr	Met	Lys	Thr	Leu	Asn	Pro	Thr	His	Asp	Ile	Ile
	130					135					140				
Ala	Leu	Cys	Glu	Phe	Glu	Asn	Ile	Val	Thr	Ser	Lys	Lys	Val	Ile	Ile
145				150						155					160
Pro	Thr	Tyr	Leu	Arg	Ser	Ile	Ser	Val	Arg	Asn	Lys	Asp	Leu	Asn	Thr
				165					170					175	
Leu	Glu	Asn	Ile	Thr	Thr	Thr	Glu	Phe	Lys	Asn	Ala	Ile	Thr	Asn	Ala
			180					185					190		
Lys	Ile	Ile	Pro	Tyr	Ser	Gly	Leu	Leu	Leu	Val	Ile	Thr	Val	Thr	Asp
		195				200						205			
Asn	Lys	Gly	Ala	Phe	Lys	Tyr	Ile	Lys	Pro	Gln	Ser	Gln	Phe	Ile	Val
	210				215						220				
Asp	Leu	Gly	Ala	Tyr	Leu	Glu	Lys	Glu	Ser	Ile	Tyr	Tyr	Val	Thr	Thr
225				230						235					240
Asn	Trp	Lys	His	Thr	Ala	Thr	Arg	Phe	Ala	Ile	Lys	Pro	Met	Glu	Asp
				245					250					255	

<210> 399
 <211> 1185
 <212> DNA
 <213> Human metapneumovirus

<220>
 <221> CDS
 <222> (1)...(1185)
 <223> Nucleoprotein (N)

<400> 399
 atg tct ctt caa ggg att cac ctg agt gat tta tca tac aag cat gct 48
 Met Ser Leu Gln Gly Ile His Leu Ser Asp Leu Ser Tyr Lys His Ala
 1 5 10 15
 ata tta aaa gag tct cag tac aca ata aaa aga gat gtg ggt aca aca 96
 Ile Leu Lys Glu Ser Gln Tyr Thr Ile Lys Arg Asp Val Gly Thr Thr
 20 25 30
 act gca gtg aca ccc tca tca ttg caa caa gaa ata aca ctg ttg tgt 144
 Thr Ala Val Thr Pro Ser Ser Leu Gln Gln Glu Ile Thr Leu Leu Cys
 35 40 45
 gga gaa att ctg tat gct aaa cat gct gac tac aaa tat gct gca gaa 192
 Gly Glu Ile Leu Tyr Ala Lys His Ala Asp Tyr Lys Tyr Ala Ala Glu
 50 55 60
 ata gga ata caa tat att agc aca gct tta gga tca gag aga gtg cag 240
 Ile Gly Ile Gln Tyr Ile Ser Thr Ala Leu Gly Ser Glu Arg Val Gln
 65 70 75 80
 cag att ctg agg aac tca ggc agt gaa gtc caa gtg gtc tta acc aga 288
 Gln Ile Leu Arg Asn Ser Gly Ser Glu Val Gln Val Val Leu Thr Arg
 85 90 95
 acg tac tct ctg ggg aaa att aaa aac aat aaa gga gaa gat tta cag 336
 Thr Tyr Ser Leu Gly Lys Ile Lys Asn Asn Lys Gly Glu Asp Leu Gln
 100 105 110
 atg tta gac ata cac ggg gta gag aag agc tgg gta gaa gag ata gac 384
 Met Leu Asp Ile His Gly Val Glu Lys Ser Trp Val Glu Glu Ile Asp
 115 120 125
 aaa gaa gca agg aaa aca atg gca acc ttg ctt aag gaa tca tca ggt 432
 Lys Glu Ala Arg Lys Thr Met Ala Thr Leu Leu Lys Glu Ser Ser Gly
 130 135 140
 aat atc cca caa aat cag agg ccc tca gca cca gac aca ccc ata atc 480
 Asn Ile Pro Gln Asn Gln Arg Pro Ser Ala Pro Asp Thr Pro Ile Ile
 145 150 155 160
 tta tta tgt gta ggt gcc tta ata ttc act aaa cta gca tca acc ata 528
 Leu Leu Cys Val Gly Ala Leu Ile Phe Thr Lys Leu Ala Ser Thr Ile
 165 170 175
 gaa gtg gga cta gag acc aca gtc aga agg gct aac cgt gta cta agt 576
 Glu Val Gly Leu Glu Thr Thr Val Arg Arg Ala Asn Arg Val Leu Ser
 180 185 190
 gat gca ctc aag aga tac cct aga atg gac ata cca aag att gcc aga 624
 Asp Ala Leu Lys Arg Tyr Pro Arg Met Asp Ile Pro Lys Ile Ala Arg
 195 200 205
 tcc ttc tat gac tta ttt gaa caa aaa gtg tat cac aga agt ttg ttc 672
 Ser Phe Tyr Asp Leu Phe Glu Lys Val Tyr His Arg Ser Leu Phe
 210 215 220
 att gag tat ggc aaa gca tta ggc tca tca tct aca ggc agc aaa gca 720
 Ile Glu Tyr Gly Lys Ala Leu Gly Ser Ser Ser Thr Gly Ser Lys Ala
 225 230 235 240
 gaa agt cta ttt gtt aat ata ttc atg caa gct tat ggg gcc ggt caa 768
 Glu Ser Leu Phe Val Asn Ile Phe Met Gln Ala Tyr Gly Ala Gly Gln
 245 250 255
 aca atg cta agg tgg ggg gtc att gcc agg tca tcc aac aat ata atg 816

```

Thr Met Leu Arg Trp Gly Val Ile Ala Arg Ser Ser Asn Asn Ile Met
      260      265      270
tta gga cat gta tcc gtc caa gct gag tta aaa cag gtc aca gaa gtc 864
Leu Gly His Val Ser Val Gln Ala Glu Leu Lys Gln Val Thr Glu Val
      275      280      285
tat gac ttg gtg cga gaa atg ggc cct gaa tct gga ctt cta cat tta 912
Tyr Asp Leu Val Arg Glu Met Gly Pro Glu Ser Gly Leu Leu His Leu
      290      295      300
agg caa agc cca aaa gct gga ctg tta tca cta gcc aac tgt ccc aac 960
Arg Gln Ser Pro Lys Ala Gly Leu Leu Ser Leu Ala Asn Cys Pro Asn
      305      310      315      320
ttt gca agt gtt gtt ctc gga aat gcc tca ggc tta ggc ata atc ggt 1008
Phe Ala Ser Val Val Leu Gly Asn Ala Ser Gly Leu Gly Ile Ile Gly
      325      330      335
atg tat cga ggg aga gta cca aac aca gaa tta ttt tca gca gct gaa 1056
Met Tyr Arg Gly Arg Val Pro Asn Thr Glu Leu Phe Ser Ala Ala Glu
      340      345      350
agt tat gcc aaa agt ttg aaa gaa agc aat aaa ata aat ttc tct tca 1104
Ser Tyr Ala Lys Ser Leu Lys Glu Ser Asn Lys Ile Asn Phe Ser Ser
      355      360      365
tta gga ctt aca gat gaa gag aaa gag gct gca gaa cat ttc tta aat 1152
Leu Gly Leu Thr Asp Glu Glu Lys Glu Ala Ala Glu His Phe Leu Asn
      370      375      380
gtg agt gac gac agt caa aat gat tat gag taa 1185
Val Ser Asp Asp Ser Gln Asn Asp Tyr Glu *
      385      390

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<210> 400

<211> 885

<212> DNA

<213> Human metapneumovirus

<220>

<221> CDS

<222> (1)...(885)

<223> Phosphoprotein (P)

<400> 400

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atg tca ttc cct gaa gga aaa gat att ctt ttc atg ggt aat gaa gca 48
Met Ser Phe Pro Glu Gly Lys Asp Ile Leu Phe Met Gly Asn Glu Ala
      1      5      10      15
gca aaa tta gca gaa gct ttc cag aaa tca tta aga aaa cca ggt cat 96
Ala Lys Leu Ala Glu Ala Phe Gln Lys Ser Leu Arg Lys Pro Gly His
      20      25      30
aaa aga tct caa tct att ata gga gaa aaa gtg aat act gta tca gaa 144
Lys Arg Ser Gln Ser Ile Ile Gly Glu Lys Val Asn Thr Val Ser Glu
      35      40      45
aca ttg gaa tta cct act atc agt aga cct gca aaa cca acc ata ccg 192
Thr Leu Glu Leu Pro Thr Ile Ser Arg Pro Ala Lys Pro Thr Ile Pro
      50      55      60
tca gaa cca aag tta gca tgg aca gat aaa ggt ggg gca acc aaa act 240
Ser Glu Pro Lys Leu Ala Trp Thr Asp Lys Gly Gly Ala Thr Lys Thr
      65      70      75      80
gaa ata aag caa gca atc aaa gtc atg gat ccc att gaa gaa gaa gag 288
Glu Ile Lys Gln Ala Ile Lys Val Met Asp Pro Ile Glu Glu Glu Glu
      85      90      95
tct acc gag aag aag gtg cta ccc tcc agt gat ggg aaa acc cct gca 336
Ser Thr Glu Lys Lys Val Leu Pro Ser Ser Asp Gly Lys Thr Pro Ala
      100      105      110
gaa aag aaa ctg aaa cca tca act aac acc aaa aag aag gtt tca ttt 384
Glu Lys Lys Leu Lys Pro Ser Thr Asn Thr Lys Lys Lys Val Ser Phe

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      115              120              125
aca cca aat gaa cca ggg aaa tat aca aag ttg gaa aaa gat gct cta 432
Thr Pro Asn Glu Pro Gly Lys Tyr Thr Lys Leu Glu Lys Asp Ala Leu
      130              135              140
gat ttg ctc tca gat aat gaa gaa gaa gat gca gaa tct tca atc tta 480
Asp Leu Leu Ser Asp Asn Glu Glu Glu Asp Ala Glu Ser Ser Ile Leu
      145              150              155              160
acc ttt gaa gaa aga gat act tca tca tta agc att gag gcc aga ttg 528
Thr Phe Glu Glu Arg Asp Thr Ser Ser Leu Ser Ile Glu Ala Arg Leu
      165              170              175
gaa tca ata gag gag aaa tta agc atg ata tta ggg cta tta aga aca 576
Glu Ser Ile Glu Glu Lys Leu Ser Met Ile Leu Gly Leu Leu Arg Thr
      180              185              190
ctc aac att gct aca gca gga ccc aca gca gca aga gat ggg atc aga 624
Leu Asn Ile Ala Thr Ala Gly Pro Thr Ala Ala Arg Asp Gly Ile Arg
      195              200              205
gat gca atg att ggc gta aga gag gaa tta ata gca gac ata ata aag 672
Asp Ala Met Ile Gly Val Arg Glu Glu Leu Ile Ala Asp Ile Ile Lys
      210              215              220
gaa gct aaa ggg aaa gca gca gaa atg atg gaa gag gaa atg agt caa 720
Glu Ala Lys Gly Lys Ala Ala Glu Met Met Glu Glu Glu Met Ser Gln
      225              230              235              240
cga tca aaa ata gga aat ggt agt gta aaa tta aca gaa aaa gca aaa 768
Arg Ser Lys Ile Gly Asn Gly Ser Val Lys Leu Thr Glu Lys Ala Lys
      245              250              255
gag ctc aac aaa att gtt gaa gat gaa agc aca agt gga gaa tcc gaa 816
Glu Leu Asn Lys Ile Val Glu Asp Glu Ser Thr Ser Gly Glu Ser Glu
      260              265              270
gaa gaa gaa gaa cca aaa gac aca caa gac aat agt caa gaa gat gac 864
Glu Glu Glu Glu Pro Lys Asp Thr Gln Asp Asn Ser Gln Glu Asp Asp
      275              280              285
att tac cag tta att atg tag 885
Ile Tyr Gln Leu Ile Met *
      290

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<210> 401
 <211> 765
 <212> DNA
 <213> Human metapneumovirus

<220>
 <221> CDS
 <222> (1)...(765)
 <223> Matrix Protein (M)

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<400> 401
atg gag tcc tac cta gta gac acc tat caa ggc att cct tac aca gca 48
Met Glu Ser Tyr Leu Val Asp Thr Tyr Gln Gly Ile Pro Tyr Thr Ala
      1              5              10              15
gct gtt caa gtt gat cta ata gaa aag gac ctg tta cct gca agc cta 96
Ala Val Gln Val Asp Leu Ile Glu Lys Asp Leu Leu Pro Ala Ser Leu
      20              25              30
aca ata tgg ttc cct ttg ttt cag gcc aac aca cca cca gca gtg ctg 144
Thr Ile Trp Phe Pro Leu Phe Gln Ala Asn Thr Pro Pro Ala Val Leu
      35              40              45
ctc gat cag cta aaa acc ctg aca ata acc act ctg tat gct gca tca 192
Leu Asp Gln Leu Lys Thr Leu Thr Ile Thr Thr Leu Tyr Ala Ala Ser
      50              55              60
caa aat ggt cca ata ctc aaa gtg aat gca tca gcc caa ggt gca gca 240
Gln Asn Gly Pro Ile Leu Lys Val Asn Ala Ser Ala Gln Gly Ala Ala

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65	atg tct gta ctt ccc	70	aaa aaa ttt gaa gtc	75	aat gcg act gta gca ctc	80	
Met Ser Val Leu Pro	Lys Lys Phe Glu Val	Asn Ala Thr Val Ala Leu					288
	85	90					
gat gaa tat agc aaa	ctg gaa ttt gac aaa	ctc aca gtc tgt gaa gta					336
Asp Glu Tyr Ser Lys	Leu Glu Phe Asp Lys	Leu Thr Val Cys Glu Val					
	100	105					
aaa aca gtt tac tta	aca acc atg aaa cca	tac ggg atg gta tca aaa					384
Lys Thr Val Tyr Leu	Thr Thr Met Lys Pro	Tyr Gly Met Val Ser Lys					
	115	120					
ttt gtg agc tca gcc	aaa tca gtt ggc aaa	aaa aca cat gat cta atc					432
Phe Val Ser Ser Ala	Lys Ser Val Gly Lys	Lys Thr His Asp Leu Ile					
	130	135					
gca cta tgt gat ttt	atg gat cta gaa aag	aac aca cct gtt aca ata					480
Ala Leu Cys Asp Phe	Met Asp Leu Glu Lys	Asn Thr Pro Val Thr Ile					
	145	150					
cca gca ttc atc aaa	tca gtt tca atc aaa	gag agt gag tca gct act					528
Pro Ala Phe Ile Lys	Ser Val Ser Ile Lys	Glu Ser Glu Ser Ala Thr					
	165	170					
gtt gaa gct gct ata	agc agt gaa gca gac	caa gct cta aca cag gcc					576
Val Glu Ala Ala Ile	Ser Ser Glu Ala Asp	Gln Ala Leu Thr Gln Ala					
	180	185					
aaa att gca cct tat	gcg gga tta att atg	atc atg act atg aac aat					624
Lys Ile Ala Pro Tyr	Ala Gly Leu Ile Met	Ile Met Thr Met Asn Asn					
	195	200					
ccc aaa ggc ata ttc	aaa aag ctt gga gct	ggg act caa gtc ata gta					672
Pro Lys Gly Ile Phe	Lys Lys Leu Gly Ala	Gly Thr Gln Val Ile Val					
	210	215					
gaa cta gga gca tat	gtc cag gct gaa agc	ata agc aaa ata tgc aag					720
Glu Leu Gly Ala Tyr	Val Gln Ala Glu Ser	Ile Ser Lys Ile Cys Lys					
	225	230					
act tgg agc cat caa	ggg aca aga tat gtc	ttg aag tcc aga taa					765
Thr Trp Ser His Gln	Gly Thr Arg Tyr Val	Leu Lys Ser Arg *					
	245	250					

<210> 402

<211> 564

<212> DNA

<213> Human metapneumovirus

<220>

<221> CDS

<222> (1)...(564)

<223> Matrix Protein 2-1 (M2)

<400> 402

atg tct cgc aag gct	ccg tgc aaa tat	gaa gtg cgg ggc	aaa tgc aat	48
Met Ser Arg Lys Ala	Pro Cys Lys Tyr	Glu Val Arg Gly	Lys Cys Asn	
1	5	10	15	
aga gga agt gag tgc	aag ttt aac cac	aat tac tgg agt	tgg cca gat	96
Arg Gly Ser Glu Cys	Lys Phe Asn His	Asn Tyr Trp Ser	Trp Pro Asp	
	20	25	30	
aga tac tta tta ata	aga tca aat tat	tta tta aat caa	ctt tta agg	144
Arg Tyr Leu Leu Ile	Arg Ser Asn Tyr	Leu Leu Asn Gln	Leu Leu Arg	
	35	40	45	
aac act gat aga gct	gat ggc tta tca	ata ata tca gga	gca ggc aga	192
Asn Thr Asp Arg Ala	Asp Gly Leu Ser	Ile Ile Ser Gly	Ala Gly Arg	
	50	55	60	
gaa gat agg aca caa	gat ttt gtc cta	ggt tcc acc aat	gtg gtt caa	240
Glu Asp Arg Thr Gln	Asp Phe Val Leu	Gly Ser Thr Asn	Val Val Gln	
65	70	75	80	

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ggt tat att gat gat aac caa agc ata aca aaa gct gca gcc tgt tac 288
Gly Tyr Ile Asp Asp Asn Gln Ser Ile Thr Lys Ala Ala Ala Cys Tyr
      85                      90                      95
agt cta cat aat ata atc aaa caa cta caa gaa gtt gaa gtt agg cag 336
Ser Leu His Asn Ile Ile Lys Gln Leu Gln Glu Val Glu Val Arg Gln
      100                    105                    110
gct aga gat aac aaa cta tct gac agc aaa cat gta gca ctt cac aac 384
Ala Arg Asp Asn Lys Leu Ser Asp Ser Lys His Val Ala Leu His Asn
      115                    120                    125
tta gtc cta tct tat atg gag atg agc aaa act cct gca tct tta atc 432
Leu Val Leu Ser Tyr Met Glu Met Ser Lys Thr Pro Ala Ser Leu Ile
      130                    135                    140
aac aat ctc aag aga ctg ccg aga gag aaa ctg aaa aaa tta gca aag 480
Asn Asn Leu Lys Arg Leu Pro Arg Glu Lys Leu Lys Lys Leu Ala Lys
      145                    150                    155                    160
ctc ata att gac tta tca gca ggt gct gaa aat gac tct tca tat gcc 528
Leu Ile Ile Asp Leu Ser Ala Gly Ala Glu Asn Asp Ser Ser Tyr Ala
      165                    170                    175
ttg caa gac agt gaa agc act aat caa gtg cag tga 564
Leu Gln Asp Ser Glu Ser Thr Asn Gln Val Gln *
      180                    185

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<210> 403
 <211> 216
 <212> DNA
 <213> Human metapneumovirus

<220>
 <221> CDS
 <222> (1)...(216)
 <223> Matrix Protein 2-2 (M2)

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<400> 403
atg act ctt cat atg cct tgc aag aca gtg aaa gca cta atc aag tgc 48
Met Thr Leu His Met Pro Cys Lys Thr Val Lys Ala Leu Ile Lys Cys
  1                      5                      10                      15
agt gag cat ggt cca gtt ttc att act ata gag gtt gat gac atg ata 96
Ser Glu His Gly Pro Val Phe Ile Thr Ile Glu Val Asp Asp Met Ile
      20                    25                    30
tgg act cac aag gac tta aaa gaa gct tta tct gat ggg ata gtg aag 144
Trp Thr His Lys Asp Leu Lys Glu Ala Leu Ser Asp Gly Ile Val Lys
      35                    40                    45
tct cat act aac att tac aat tgt tat tta gaa aac ata gaa att ata 192
Ser His Thr Asn Ile Tyr Asn Cys Tyr Leu Glu Asn Ile Glu Ile Ile
      50                    55                    60
tat gtc aag gct tac tta agt tag 216
Tyr Val Lys Ala Tyr Leu Ser *
  65                      70

```

<210> 404
 <211> 552
 <212> DNA
 <213> Human metapneumovirus

<220>
 <221> CDS
 <222> (1)...(552)
 <223> Small Hydrophobic Protein (SH)

<400> 404

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atg ata aca tta gat gtc att aaa agt gat ggg tct tca aaa aca tgt 48
Met Ile Thr Leu Asp Val Ile Lys Ser Asp Gly Ser Ser Lys Thr Cys
1 5 10 15
act cac ctc aaa aaa ata att aaa gac cac tct ggt aaa gtg ctt att 96
Thr His Leu Lys Lys Ile Ile Lys Asp His Ser Gly Lys Val Leu Ile
20 25 30
gta ctt aag tta ata tta gct tta cta aca ttt ctc aca gta aca atc 144
Val Leu Lys Leu Ile Leu Ala Leu Leu Thr Phe Leu Thr Val Thr Ile
35 40 45
acc atc aat tat ata aaa gtg gaa aac aat ctg caa ata tgc cag tca 192
Thr Ile Asn Tyr Ile Lys Val Glu Asn Asn Leu Gln Ile Cys Gln Ser
50 55 60
aaa act gaa tca gac aaa aag gac tca tca tca aat acc aca tca gtc 240
Lys Thr Glu Ser Asp Lys Lys Asp Ser Ser Ser Asn Thr Thr Ser Val
65 70 75 80
aca acc aag act act cta aat cat gat atc aca cag tat ttt aaa agt 288
Thr Thr Lys Thr Thr Leu Asn His Asp Ile Thr Gln Tyr Phe Lys Ser
85 90 95
ttg att caa agg tat aca aac tct gca ata aac agt gac aca tgc tgg 336
Leu Ile Gln Arg Tyr Thr Asn Ser Ala Ile Asn Ser Asp Thr Cys Trp
100 105 110
aaa ata aac aga aat caa tgc aca aat ata aca aca tac aaa ttt tta 384
Lys Ile Asn Arg Asn Gln Cys Thr Asn Ile Thr Thr Tyr Lys Phe Leu
115 120 125
tgt ttt aaa tct gaa gac aca aaa acc aac aat tgt gat aaa ctg aca 432
Cys Phe Lys Ser Glu Asp Thr Lys Thr Asn Asn Cys Asp Lys Leu Thr
130 135 140
gat tta tgc aga aac aaa cca aaa cca gca gtt gga gtg tat cac ata 480
Asp Leu Cys Arg Asn Lys Pro Lys Pro Ala Val Gly Val Tyr His Ile
145 150 155 160
gta gaa tgc cat tgt ata tac aca gtt aaa tgg aag tgc tat cat tac 528
Val Glu Cys His Cys Ile Tyr Thr Val Lys Trp Lys Cys Tyr His Tyr
165 170 175
cca acc gat gaa acc caa tcc taa 552
Pro Thr Asp Glu Thr Gln Ser *
180

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<210> 405
 <211> 2005
 <212> PRT
 <213> Human metapneumovirus

<220>
 <223> RNA-dependent RNA polymerase (L) of Human metapneumovirus

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<400> 405
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1 5 10 15
Tyr Leu Lys Gly Val Ile Ser Phe Ser Glu Thr Asn Ala Ile Gly Ser
20 25 30
Cys Leu Leu Lys Arg Pro Tyr Leu Lys Asn Asp Asn Thr Ala Lys Val
35 40 45
Ala Ile Glu Asn Pro Val Ile Glu His Val Arg Leu Lys Asn Ala Val
50 55 60
Asn Ser Lys Met Lys Ile Ser Asp Tyr Lys Ile Val Glu Pro Val Asn
65 70 75 80
Met Gln His Glu Ile Met Lys Asn Val His Ser Cys Glu Leu Thr Leu
85 90 95
Leu Lys Gln Phe Leu Thr Arg Ser Lys Asn Ile Ser Thr Leu Lys Leu
100 105 110

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Asn	Met	Ile	Cys	Asp	Trp	Leu	Gln	Leu	Lys	Ser	Thr	Ser	Asp	Asp	Thr
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Ser	Ile	Leu	Ser	Phe	Ile	Asp	Val	Glu	Phe	Ile	Pro	Ser	Trp	Val	Ser
		130				135					140				
Asn	Trp	Phe	Ser	Asn	Trp	Tyr	Asn	Leu	Asn	Lys	Leu	Ile	Leu	Glu	Phe
145					150					155					160
Arg	Lys	Glu	Glu	Val	Ile	Arg	Thr	Gly	Ser	Ile	Leu	Cys	Arg	Ser	Leu
				165					170					175	
Gly	Lys	Leu	Val	Phe	Val	Val	Ser	Ser	Tyr	Gly	Cys	Ile	Val	Lys	Ser
			180					185					190		
Asn	Lys	Ser	Lys	Arg	Val	Ser	Phe	Phe	Thr	Tyr	Asn	Gln	Leu	Leu	Thr
		195					200					205			
Trp	Lys	Asp	Val	Met	Leu	Ser	Arg	Phe	Asn	Ala	Asn	Phe	Cys	Ile	Trp
		210				215					220				
Val	Ser	Asn	Ser	Leu	Asn	Glu	Asn	Gln	Glu	Gly	Leu	Gly	Leu	Arg	Ser
225					230					235					240
Asn	Leu	Gln	Gly	Ile	Leu	Thr	Asn	Lys	Leu	Tyr	Glu	Thr	Val	Asp	Tyr
				245					250					255	
Met	Leu	Ser	Leu	Cys	Cys	Asn	Glu	Gly	Phe	Ser	Leu	Val	Lys	Glu	Phe
			260					265					270		
Glu	Gly	Phe	Ile	Met	Ser	Glu	Ile	Leu	Arg	Ile	Thr	Glu	His	Ala	Gln
		275					280					285			
Phe	Ser	Thr	Arg	Phe	Arg	Asn	Thr	Leu	Leu	Asn	Gly	Leu	Thr	Asp	Gln
		290				295					300				
Leu	Thr	Lys	Leu	Lys	Asn	Lys	Asn	Arg	Leu	Arg	Val	His	Gly	Thr	Val
305					310					315					320
Leu	Glu	Asn	Asn	Asp	Tyr	Pro	Met	Tyr	Glu	Val	Val	Leu	Lys	Leu	Leu
				325					330					335	
Gly	Asp	Thr	Leu	Arg	Cys	Ile	Lys	Leu	Leu	Ile	Asn	Lys	Asn	Leu	Glu
			340					345					350		
Asn	Ala	Ala	Glu	Leu	Tyr	Tyr	Ile	Phe	Arg	Ile	Phe	Gly	His	Pro	Met
		355					360					365			
Val	Asp	Glu	Arg	Asp	Ala	Met	Asp	Ala	Val	Lys	Leu	Asn	Asn	Glu	Ile
		370				375					380				
Thr	Lys	Ile	Leu	Arg	Trp	Glu	Ser	Leu	Thr	Glu	Leu	Arg	Gly	Ala	Phe
385					390					395					400
Ile	Leu	Arg	Ile	Ile	Lys	Gly	Phe	Val	Asp	Asn	Asn	Lys	Arg	Trp	Pro
				405					410					415	
Lys	Ile	Lys	Asn	Leu	Lys	Val	Leu	Ser	Lys	Arg	Trp	Thr	Met	Tyr	Phe
			420					425					430		
Lys	Ala	Lys	Ser	Tyr	Pro	Ser	Gln	Leu	Glu	Leu	Ser	Glu	Gln	Asp	Phe
		435					440					445			
Leu	Glu	Leu	Ala	Ala	Ile	Gln	Phe	Glu	Gln	Glu	Phe	Ser	Val	Pro	Glu
		450				455					460				
Lys	Thr	Asn	Leu	Glu	Met	Val	Leu	Asn	Asp	Lys	Ala	Ile	Ser	Pro	Pro
465					470					475					480
Lys	Arg	Leu	Ile	Trp	Ser	Val	Tyr	Pro	Lys	Asn	Tyr	Leu	Pro	Glu	Lys
				485					490					495	
Ile	Lys	Asn	Arg	Tyr	Leu	Glu	Glu	Thr	Phe	Asn	Ala	Ser	Asp	Ser	Leu
			500					505					510		
Lys	Thr	Arg	Arg	Val	Leu	Glu	Tyr	Tyr	Leu	Lys	Asp	Asn	Lys	Phe	Asp
		515					520					525			
Gln	Lys	Glu	Leu	Lys	Ser	Tyr	Val	Val	Lys	Gln	Glu	Tyr	Leu	Asn	Asp
		530				535					540				
Lys	Asp	His	Ile	Val	Ser	Leu	Thr	Gly	Lys	Glu	Arg	Glu	Leu	Ser	Val
545					550					555					560
Gly	Arg	Met	Phe	Ala	Met	Gln	Pro	Gly	Lys	Gln	Arg	Gln	Ile	Gln	Ile
				565					570					575	
Leu	Ala	Glu	Lys	Leu	Leu	Ala	Asp	Asn	Ile	Val	Pro	Phe	Phe	Pro	Glu
			580					585					590		
Thr	Leu	Thr	Lys	Tyr	Gly	Asp	Leu	Asp	Leu	Gln	Arg	Ile	Met	Glu	Ile

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Arg Ala Val Ser Met Met Leu Glu Asn Leu Gly Leu Leu Ser Arg Ile
 1090 1095 1100
 Leu Ser Val Val Val Asp Ser Ile Glu Ile Pro Thr Lys Ser Asn Gly
 1105 1110 1115 1120
 Arg Leu Ile Cys Cys Gln Ile Ser Arg Thr Leu Arg Glu Thr Ser Trp
 1125 1130 1135
 Asn Asn Met Glu Ile Val Gly Val Thr Ser Pro Ser Ile Thr Thr Cys
 1140 1145 1150
 Met Asp Val Ile Tyr Ala Thr Ser Ser His Leu Lys Gly Ile Ile Ile
 1155 1160 1165
 Glu Lys Phe Ser Thr Asp Arg Thr Thr Arg Gly Gln Arg Gly Pro Lys
 1170 1175 1180
 Ser Pro Trp Val Gly Ser Ser Thr Gln Glu Lys Lys Leu Val Pro Val
 1185 1190 1195 1200
 Tyr Asn Arg Gln Ile Leu Ser Lys Gln Gln Arg Glu Gln Leu Glu Ala
 1205 1210 1215
 Ile Gly Lys Met Arg Trp Val Tyr Lys Gly Thr Pro Gly Leu Arg Arg
 1220 1225 1230
 Leu Leu Asn Lys Ile Cys Leu Gly Ser Leu Gly Ile Ser Tyr Lys Cys
 1235 1240 1245
 Val Lys Pro Leu Leu Pro Arg Phe Met Ser Val Asn Phe Leu His Arg
 1250 1255 1260
 Leu Ser Val Ser Ser Arg Pro Met Glu Phe Pro Ala Ser Val Pro Ala
 1265 1270 1275 1280
 Tyr Arg Thr Thr Asn Tyr His Phe Asp Thr Ser Pro Ile Asn Gln Ala
 1285 1290 1295
 Leu Ser Glu Arg Phe Gly Asn Glu Asp Ile Asn Leu Val Phe Gln Asn
 1300 1305 1310
 Ala Ile Ser Cys Gly Ile Ser Ile Met Ser Val Val Glu Gln Leu Thr
 1315 1320 1325
 Gly Arg Ser Pro Lys Gln Leu Val Leu Ile Pro Gln Leu Glu Glu Ile
 1330 1335 1340
 Asp Ile Met Pro Pro Pro Val Phe Gln Gly Lys Phe Asn Tyr Lys Leu
 1345 1350 1355 1360
 Val Asp Lys Ile Thr Ser Asp Gln His Ile Phe Ser Pro Asp Lys Ile
 1365 1370 1375
 Asp Met Leu Thr Leu Gly Lys Met Leu Met Pro Thr Ile Lys Gly Gln
 1380 1385 1390
 Lys Thr Asp Gln Phe Leu Asn Lys Arg Glu Asn Tyr Phe His Gly Asn
 1395 1400 1405
 Asn Leu Ile Glu Ser Leu Ser Ala Ala Leu Ala Cys His Trp Cys Gly
 1410 1415 1420
 Ile Leu Thr Glu Gln Cys Ile Glu Asn Asn Ile Phe Lys Lys Asp Trp
 1425 1430 1435 1440
 Gly Asp Gly Phe Ile Ser Asp His Ala Phe Met Asp Phe Lys Ile Phe
 1445 1450 1455
 Leu Cys Val Phe Lys Thr Lys Leu Leu Cys Ser Trp Gly Ser Gln Gly
 1460 1465 1470
 Lys Asn Ile Lys Asp Glu Asp Ile Val Asp Glu Ser Ile Asp Lys Leu
 1475 1480 1485
 Leu Arg Ile Asp Asn Thr Phe Trp Arg Met Phe Ser Lys Val Met Phe
 1490 1495 1500
 Glu Ser Lys Val Lys Lys Arg Ile Met Leu Tyr Asp Val Lys Phe Leu
 1505 1510 1515 1520
 Ser Leu Val Gly Tyr Ile Gly Phe Lys Asn Trp Phe Ile Glu Gln Leu
 1525 1530 1535
 Arg Ser Ala Glu Leu His Glu Val Pro Trp Ile Val Asn Ala Glu Gly
 1540 1545 1550
 Asp Leu Val Glu Ile Lys Ser Ile Lys Ile Tyr Leu Gln Leu Ile Glu
 1555 1560 1565
 Gln Ser Leu Phe Leu Arg Ile Thr Val Leu Asn Tyr Thr Asp Met Ala

1570	1575	1580
His Ala Leu Thr Arg	Leu Ile Arg Lys Lys	Leu Met Cys Asp Asn Ala
1585	1590	1595
Leu Leu Thr Pro Ile	Pro Ser Pro Met Val	Asn Leu Thr Gln Val Ile
1605	1610	1615
Asp Pro Thr Glu Gln	Leu Ala Tyr Phe Pro	Lys Ile Thr Phe Glu Arg
1620	1625	1630
Leu Lys Asn Tyr Asp	Thr Ser Ser Asn Tyr	Ala Lys Gly Lys Leu Thr
1635	1640	1645
Arg Asn Tyr Met Ile	Leu Leu Pro Trp Gln	His Val Asn Arg Tyr Asn
1650	1655	1660
Phe Val Phe Ser Ser	Thr Gly Cys Lys Val	Ser Leu Lys Thr Cys Ile
1665	1670	1675
Gly Lys Leu Met Lys	Asp Leu Asn Pro Lys	Val Leu Tyr Phe Ile Gly
1685	1690	1695
Glu Gly Ala Gly Asn	Trp Met Ala Arg Thr	Ala Cys Glu Tyr Pro Asp
1700	1705	1710
Ile Lys Phe Val Tyr	Arg Ser Leu Lys Asp	Asp Leu Asp His His Tyr
1715	1720	1725
Pro Leu Glu Tyr Gln	Arg Val Ile Gly Glu	Leu Ser Arg Ile Ile Asp
1730	1735	1740
Ser Gly Glu Gly Leu	Ser Met Glu Thr Thr	Asp Ala Thr Gln Lys Thr
1745	1750	1755
His Trp Asp Leu Ile	His Arg Val Ser Lys	Asp Ala Leu Leu Ile Thr
1765	1770	1775
Leu Cys Asp Ala Glu	Phe Lys Asp Arg Asp	Asp Phe Phe Lys Met Val
1780	1785	1790
Ile Leu Trp Arg Lys	His Val Leu Ser Cys	Arg Ile Cys Thr Thr Tyr
1795	1800	1805
Gly Thr Asp Leu Tyr	Leu Phe Ala Lys Tyr	His Ala Lys Asp Cys Asn
1810	1815	1820
Val Lys Leu Pro Phe	Phe Val Arg Ser Val	Ala Thr Phe Ile Met Gln
1825	1830	1835
Gly Ser Lys Leu Ser	Gly Ser Glu Cys Tyr	Ile Leu Leu Thr Leu Gly
1845	1850	1855
His His Asn Asn Leu	Pro Cys His Gly Glu	Ile Gln Asn Ser Lys Met
1860	1865	1870
Lys Ile Ala Val Cys	Asn Asp Phe Tyr Ala	Ala Lys Lys Leu Asp Asn
1875	1880	1885
Lys Ser Ile Glu Ala	Asn Cys Lys Ser Leu	Leu Ser Gly Leu Arg Ile
1890	1895	1900
Pro Ile Asn Lys Lys	Glu Leu Asn Arg Gln	Arg Arg Leu Leu Thr Leu
1905	1910	1915
Gln Ser Asn His Ser	Ser Val Ala Thr Val	Gly Gly Ser Lys Val Ile
1925	1930	1935
Glu Ser Lys Trp Leu	Thr Asn Lys Ala Asn	Thr Ile Ile Asp Trp Leu
1940	1945	1950
Glu His Ile Leu Asn	Ser Pro Lys Gly Glu	Leu Asn Tyr Asp Phe Phe
1955	1960	1965
Glu Ala Leu Glu Asn	Thr Tyr Pro Asn Met	Ile Lys Leu Ile Asp Asn
1970	1975	1980
Leu Gly Asn Ala Glu	Ile Lys Lys Leu Ile	Lys Val Thr Gly Tyr Met
1985	1990	1995
Leu Val Ser Lys Lys		2000
2005		

<210> 406

<211> 13350

<212> DNA

<213> Human metapneumovirus

<220>

<223> RNA-dependent RNA polymerase (L) of Human metapneumovirus

<400> 406

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gatgtgggta caacaactgc agtgacaccc tcatcattgc aacaagaaat aacactgttg 180
tgtggagaaa ttctgtatgc taaacatgct gactacaaat atgctgcaga aataggaata 240
caatatatta gcacagcttt aggatcagag agagtgcagc agattctgag gaactcaggc 300
agtgaagtc aagtggctct aaccagaacg tactctctgg ggaaaattaa aaacaataaa 360
ggagaagatt tacagatgtt agacatacac ggggtagaga agagctgggt agaagagata 420
gacaaagaag caaggaaaac aatggcaacc ttgcttaagg aatcatcagg taatatccca 480
caaaatcaga ggcctcagc accagacaca ccataatct tattatgtgt aggtgcctta 540
atattcacta aactagcatc aaccatagaa gtgggactag agaccacagt cagaagggtc 600
aaccgtgtac taagtgatgc actcaagaga taccctagaa tggacatacc aaagattgcc 660
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ggcaaagcat taggctcatc atctacaggc agcaaagcag aaagtctatt tgттаatata 780
ttcatgcaag cttatggggc cgggtcaaaca atgctaaggt ggggggtcat tgccagggtca 840
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Human parainfluenza 1 virus

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Val	Arg	Arg	Gly	Thr	Pro	Leu	Ser	Asp	Arg	Glu	Gly	Arg	Thr	Asn	
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Asn	Asn	Gly	Arg	Ser	Met	Glu	Thr	Ser	Ser	Thr	His	Ser	Thr	Arg	Ile
		195					200					205			
Thr	Asp	Val	Ile	Thr	Asn	Pro	Ser	Pro	Glu	Leu	Glu	Asp	Ala	Val	Leu
	210				215						220				
Gln	Arg	Asn	Lys	Arg	Arg	Pro	Thr	Thr	Ile	Lys	Arg	Ser	Gln	Thr	Arg
225				230						235					240
Ser	Glu	Arg	Thr	Gln	Asn	Ser	Glu	Leu	His	Lys	Ser	Thr	Ser	Glu	Asp
			245				250							255	
Ser	Ser	Asn	Leu	Glu	Asp	His	Asn	Thr	Lys	Thr	Ser	Pro	Lys	Val	Leu
		260					265						270		
Pro	Ser	Lys	Asn	Glu	Glu	Ser	Val	Ala	Thr	Gln	Lys	Asn	Asn	His	Asn
		275					280					285			
His	Arg	Lys	Thr	Lys	Tyr	Thr	Thr	Asn	Asn	Ala	Asn	Asn	Asn	Thr	Lys
	290				295					300					
Ser	Leu	Pro	Thr	Pro	Glu	His	Asp	Thr	Thr	Ala	Asn	Glu	Glu	Gly	Thr
305				310						315					320
Ser	Asn	Thr	Ser	Val	Asp	Glu	Met	Ala	Lys	Leu	Leu	Val	Ser	Leu	Gly
			325					330						335	
Val	Ile	Lys	Ser	Gln	His	Glu	Phe	Glu	Leu	Ser	Arg	Ser	Ala	Ser	His
		340					345						350		
Val	Phe	Ala	Lys	Arg	Met	Leu	Lys	Ser	Ala	Asn	Tyr	Lys	Glu	Met	Thr
	355						360					365			
Phe	Asn	Leu	Cys	Gly	Met	Leu	Leu	Ser	Val	Glu	Lys	Ser	Leu	Glu	Asn
	370				375					380					
Lys	Val	Glu	Glu	Asn	Arg	Thr	Leu	Leu	Lys	Gln	Ile	Gln	Glu	Glu	Ile
385				390						395					400
Asp	Ser	Ser	Arg	Asp	Leu	His	Lys	Arg	Phe	Ser	Glu	Tyr	Gln	Lys	Glu
			405					410						415	
Gln	Asn	Ser	Leu	Met	Met	Ala	Asn	Leu	Ser	Thr	Leu	His	Ile	Ile	Thr
		420					425						430		
Asp	Arg	Gly	Gly	Lys	Thr	Gly	Asp	Pro	Ser	Asp	Thr	Thr	Arg	Ser	Pro
		435					440					445			
Ser	Val	Phe	Thr	Lys	Gly	Lys	Asp	Asn	Lys	Val	Lys	Lys	Thr	Arg	Phe
	450				455						460				
Asp	Pro	Ser	Met	Glu	Ala	Leu	Gly	Gly	Gln	Glu	Phe	Lys	Pro	Asp	Leu
465				470						475					480
Ile	Arg	Glu	Asp	Glu	Leu	Arg	Asp	Asp	Ile	Arg	Asn	Pro	Val	Leu	Glu
			485					490						495	
Glu	His	Asn	Asn	Glu	Pro	Gln	Ala	Ser	Asn	Ala	Ser	Arg	Leu	Ile	Pro
		500					505						510		
Ser	Thr	Glu	Lys	His	Thr	Leu	His	Ser	Leu	Lys	Leu	Val	Ile	Glu	Asn
	515						520					525			
Ser	Pro	Leu	Ser	Arg	Val	Glu	Lys	Lys	Ala	Tyr	Ile	Lys	Ser	Leu	Tyr

530 535 540
 Lys Cys Arg Thr Asn Gln Glu Val Lys Asn Val Met Glu Leu Phe Glu
 545 550 555 560
 Glu Asp Ile Asp Ser Leu Thr Asn
 565

<210> 408

<211> 2223

<212> PRT

<213> Human parainfluenza virus 1 strain Washington/1964 .

<220>

<223> L polymerase protein of Human parainfluenza 1 virus

<400> 408

Met Asp Lys Gln Glu Ser Thr Gln Asn Ser Ser Asp Ile Leu Tyr Pro
 1 5 10 15
 Glu Cys His Leu Asn Ser Pro Ile Val Lys Ser Lys Ile Ala Gln Leu
 20 25 30
 His Val Leu Leu Asp Ile Asn Gln Pro Tyr Asp Leu Lys Asp Asn Ser
 35 40 45
 Ile Ile Asn Ile Thr Lys Tyr Lys Ile Arg Asn Gly Gly Leu Ser Pro
 50 55 60
 Arg Gln Ile Lys Ile Arg Ser Leu Gly Lys Ile Leu Lys Gln Glu Ile
 65 70 75 80
 Lys Asp Ile Asp Arg Tyr Thr Phe Glu Pro Tyr Pro Ile Phe Ser Leu
 85 90 95
 Glu Leu Leu Arg Leu Asp Ile Pro Glu Ile Cys Asp Lys Ile Arg Ser
 100 105 110
 Ile Phe Ser Val Ser Asp Arg Leu Ile Arg Glu Leu Ser Ser Gly Phe
 115 120 125
 Gln Glu Leu Trp Leu Asn Ile Leu Arg Gln Leu Gly Cys Val Glu Gly
 130 135 140
 Lys Glu Gly Phe Asp Ser Leu Lys Asp Val Asp Ile Ile Pro Asp Ile
 145 150 155 160
 Thr Asp Lys Tyr Asn Lys Asn Thr Trp Tyr Arg Pro Phe Leu Thr Trp
 165 170 175
 Phe Ser Ile Lys Tyr Asp Met Arg Trp Met Gln Lys Asn Lys Ser Gly
 180 185 190
 Asn His Leu Asp Val Ser Asn Ser His Asn Phe Leu Asp Cys Lys Ser
 195 200 205
 Tyr Ile Leu Ile Ile Tyr Arg Asp Leu Val Ile Ile Ile Asn Lys Leu
 210 215 220
 Lys Leu Thr Gly Tyr Val Leu Thr Pro Glu Leu Val Leu Met Tyr Cys
 225 230 235 240
 Asp Val Val Glu Gly Arg Trp Asn Met Ser Ser Ala Gly Arg Leu Asp
 245 250 255
 Lys Arg Ser Ser Lys Ile Thr Cys Lys Gly Glu Glu Leu Trp Glu Leu
 260 265 270
 Ile Asp Ser Leu Phe Pro Asn Leu Gly Glu Asp Val Tyr Asn Ile Ile
 275 280 285
 Ser Leu Leu Glu Pro Leu Ser Leu Ala Leu Ile Gln Leu Asp Asp Pro
 290 295 300
 Val Thr Asn Leu Lys Gly Ala Phe Met Arg His Val Leu Thr Glu Leu
 305 310 315 320
 His Thr Ile Leu Ile Lys Asp Asn Ile Tyr Thr Asp Ser Glu Ala Asp
 325 330 335
 Ser Ile Met Glu Ser Leu Ile Lys Ile Phe Arg Glu Thr Ser Ile Asp
 340 345 350
 Glu Lys Ala Glu Ile Phe Ser Phe Arg Thr Phe Gly His Pro Ser
 355 360 365

Leu	Glu	Ala	Ile	Thr	Ala	Ala	Asp	Lys	Val	Arg	Thr	His	Met	Tyr	Ser	370	375	380
Ser	Lys	Lys	Ile	Ile	Leu	Lys	Thr	Leu	Tyr	Glu	Cys	His	Ala	Ile	Phe	385	390	395
Cys	Ala	Ile	Ile	Ile	Asn	Gly	Tyr	Arg	Glu	Arg	His	Gly	Gly	Gln	Trp	405	410	415
Pro	Pro	Cys	Glu	Phe	Pro	Asn	His	Val	Cys	Leu	Glu	Leu	Lys	Asn	Ala	420	425	430
Gln	Gly	Ser	Asn	Ser	Ala	Ile	Ser	Tyr	Glu	Cys	Ala	Val	Asp	Asn	Tyr	435	440	445
Ser	Ser	Phe	Ile	Gly	Phe	Lys	Phe	Leu	Lys	Phe	Ile	Glu	Pro	Gln	Leu	450	455	460
Asp	Glu	Asp	Leu	Thr	Ile	Tyr	Met	Lys	Asp	Lys	Ala	Leu	Ser	Pro	Arg	465	470	475
Lys	Ala	Ala	Trp	Asp	Ser	Val	Tyr	Pro	Asp	Ser	Asn	Leu	Tyr	Tyr	Lys	485	490	495
Val	Pro	Glu	Ser	Glu	Glu	Thr	Arg	Arg	Leu	Ile	Glu	Val	Phe	Ile	Asn	500	505	510
Asp	Asn	Asn	Phe	Asn	Pro	Ala	Asp	Ile	Ile	Asn	Tyr	Val	Glu	Ser	Gly	515	520	525
Glu	Trp	Leu	Asn	Asp	Asp	Ser	Phe	Asn	Ile	Ser	Tyr	Ser	Leu	Lys	Glu	530	535	540
Lys	Glu	Ile	Lys	Gln	Glu	Gly	Arg	Leu	Phe	Ala	Lys	Met	Thr	Tyr	Lys	545	550	555
Met	Arg	Ala	Val	Gln	Val	Leu	Ala	Glu	Thr	Leu	Leu	Ala	Lys	Gly	Val	565	570	575
Gly	Glu	Leu	Phe	Ser	Glu	Asn	Gly	Met	Val	Lys	Gly	Glu	Ile	Asp	Leu	580	585	590
Leu	Lys	Arg	Leu	Thr	Thr	Leu	Ser	Val	Ser	Gly	Val	Pro	Arg	Ser	Asn	595	600	605
Ser	Val	Tyr	Asn	Asn	Pro	Ile	Leu	His	Glu	Lys	Leu	Ile	Lys	Asn	Met	610	615	620
Asn	Lys	Cys	Asn	Ser	Asn	Gly	Tyr	Trp	Asp	Glu	Arg	Lys	Lys	Ser	Lys	625	630	635
Asn	Glu	Phe	Lys	Ala	Ala	Asp	Ser	Ser	Thr	Glu	Gly	Tyr	Glu	Thr	Leu	645	650	655
Ser	Cys	Phe	Leu	Thr	Thr	Asp	Leu	Lys	Lys	Tyr	Cys	Leu	Asn	Trp	Arg	660	665	670
Phe	Glu	Ser	Thr	Ala	Leu	Phe	Gly	Gln	Arg	Cys	Asn	Glu	Ile	Phe	Gly	675	680	685
Phe	Lys	Thr	Phe	Phe	Asn	Trp	Met	His	Pro	Ile	Leu	Glu	Lys	Ser	Thr	690	695	700
Ile	Tyr	Val	Gly	Asp	Pro	Tyr	Cys	Pro	Val	Pro	Asp	Arg	Met	His	Lys	705	710	715
Glu	Leu	Gln	Asp	His	Asp	Asp	Thr	Gly	Ile	Phe	Ile	His	Asn	Pro	Arg	725	730	735
Gly	Gly	Ile	Glu	Gly	Tyr	Cys	Gln	Lys	Leu	Trp	Thr	Leu	Ile	Ser	Ile	740	745	750
Ser	Ala	Ile	His	Leu	Ala	Ala	Val	Lys	Val	Gly	Val	Arg	Val	Ser	Ala	755	760	765
Met	Val	Gln	Gly	Asp	Asn	Gln	Ala	Ile	Ala	Val	Thr	Ser	Arg	Val	Pro	770	775	780
Val	Thr	Gln	Thr	Tyr	Lys	Gln	Lys	Lys	Thr	His	Val	Tyr	Glu	Glu	Ile	785	790	795
Thr	Arg	Tyr	Phe	Gly	Ala	Leu	Arg	Glu	Val	Met	Phe	Asp	Ile	Gly	His	805	810	815
Glu	Leu	Lys	Leu	Asn	Glu	Thr	Ile	Ile	Ser	Ser	Lys	Met	Phe	Val	Tyr	820	825	830
Ser	Lys	Arg	Ile	Tyr	Tyr	Asp	Gly	Lys	Ile	Leu	Pro	Gln	Cys	Leu	Lys	835	840	845
Ala	Leu	Thr	Arg	Cys	Val	Phe	Trp	Ser	Glu	Thr	Leu	Val	Asp	Glu	Asn			

850	855	860
Arg Ser Ala Cys Ser	Asn Ile Ala Thr Ser	Ile Ala Lys Ala Ile Glu
865	870	875
Asn Gly Tyr Ser Pro	Ile Leu Gly Tyr Cys	Ile Ala Leu Phe Lys Thr
	885	890
Cys Gln Gln Val Cys	Ile Ser Leu Gly Met	Thr Ile Asn Pro Thr Ile
	900	905
Thr Ser Thr Ile Lys	Asp Gln Tyr Phe Lys	Gly Lys Asn Trp Leu Arg
	915	920
Cys Ala Ile Leu Ile	Pro Ala Asn Ile Gly	Gly Phe Asn Tyr Met Ser
	930	935
Thr Ala Arg Cys Phe	Val Arg Asn Ile Gly	Asp Pro Ala Val Ala Ala
945	950	955
Leu Ala Asp Leu Lys	Arg Phe Ile Lys Ala	Gly Leu Leu Asp Lys Gln
	965	970
Val Leu Tyr Arg Val	Met Asn Gln Glu Pro	Gly Asp Ser Ser Phe Leu
	980	985
Asp Trp Ala Ser Asp	Pro Tyr Ser Cys Asn	Leu Pro His Ser Gln Ser
	995	1000
Ile Thr Thr Ile Ile	Lys Asn Val Thr Ala	Arg Ser Val Leu Gln Glu
	1010	1015
Ser Pro Asn Pro Leu	Leu Ser Gly Leu Phe	Ser Glu Ser Ser Ser Glu
1025	1030	1035
Glu Asp Leu Asn Leu	Ala Ser Phe Leu Met	Asp Arg Lys Ala Ile Leu
	1045	1050
Pro Arg Val Ala His	Glu Ile Leu Asp Asn	Ser Leu Thr Gly Val Arg
	1060	1065
Glu Ala Ile Ala Gly	Met Leu Asp Thr Thr	Lys Ser Leu Val Arg Ala
	1075	1080
Ser Val Arg Arg Gly	Gly Gly Leu Ser Tyr	Ser Ile Leu Arg Arg Leu Ile
	1090	1095
Asn Tyr Asp Leu Leu	Gln Tyr Glu Thr Leu	Thr Arg Thr Leu Arg Lys
1105	1110	1115
Pro Val Lys Asp Asn	Ile Glu Tyr Glu Tyr	Met Cys Ser Val Glu Leu
	1125	1130
Ala Ile Gly Leu Arg	Gln Lys Met Trp Phe	His Leu Thr Tyr Gly Arg
	1140	1145
Pro Ile His Gly Leu	Glu Thr Pro Asp Pro	Leu Glu Leu Leu Arg Gly
	1155	1160
Ser Phe Ile Glu Gly	Ser Glu Ile Cys Lys	Phe Cys Arg Ser Glu Gly
	1170	1175
Asn Asn Pro Met Tyr	Thr Trp Phe Tyr Leu	Pro Asp Asn Ile Asp Leu
1185	1190	1195
Asp Thr Leu Ser Asn	Gly Ser Pro Ala Ile	Arg Ile Pro Tyr Phe Gly
	1205	1210
Ser Ala Thr Asp Glu	Arg Ser Glu Ala Gln	Leu Gly Tyr Val Lys Asn
	1220	1225
Leu Ser Lys Pro Ala	Lys Ala Ala Ile Arg	Ile Ala Met Val Tyr Thr
	1235	1240
Trp Ala Tyr Gly Thr	Asp Glu Ile Ser Trp	Met Glu Ala Ala Leu Ile
	1250	1255
Ala Gln Thr Arg Ala	Asn Leu Ser Leu Glu	Asn Leu Lys Leu Leu Thr
1265	1270	1275
Pro Val Ser Thr Ser	Thr Asn Leu Ser His	Arg Leu Arg Asp Thr Ala
	1285	1290
Thr Gln Met Lys Phe	Ser Ser Ala Thr Leu	Val Arg Ala Ser Arg Phe
	1300	1305
Ile Thr Ile Ser Asn	Asp Asn Met Ala Leu	Lys Glu Ala Gly Glu Ser
	1315	1320
Lys Asp Thr Asn Leu	Val Tyr Gln Gln Ile	Met Leu Thr Gly Leu Ser
	1330	1335
		1340

Leu Phe Glu Phe Asn Met Arg Tyr Lys Gln Gly Ser Leu Ser Lys Pro
 1345 1350 1355 1360
 Met Ile Leu His Leu His Leu Asn Asn Lys Cys Cys Ile Ile Glu Ser
 1365 1370 1375
 Pro Gln Glu Leu Asn Ile Pro Pro Arg Ser Thr Leu Asp Leu Glu Ile
 1380 1385 1390
 Thr Gln Glu Asn Asn Lys Leu Ile Tyr Asp Pro Asp Pro Leu Lys Asp
 1395 1400 1405
 Ile Asp Leu Glu Leu Phe Ser Lys Val Arg Asp Val Val His Thr Ile
 1410 1415 1420
 Asp Met Asn Tyr Trp Ser Asp Asp Glu Ile Ile Arg Ala Thr Ser Ile
 1425 1430 1435 1440
 Cys Thr Ala Met Thr Ile Ala Asp Thr Met Ser Gln Leu Asp Arg Asp
 1445 1450 1455
 Asn Leu Lys Glu Met Ile Ala Leu Ile Asn Asp Asp Asp Ile Asn Ser
 1460 1465 1470
 Leu Ile Thr Glu Phe Met Val Ile Asp Ile Pro Leu Phe Cys Ser Thr
 1475 1480 1485
 Phe Gly Gly Ile Leu Ile Asn Gln Phe Ala Tyr Ser Leu Tyr Gly Leu
 1490 1495 1500
 Asn Val Arg Gly Arg Asp Glu Ile Trp Gly Tyr Val Ile Arg Ile Ile
 1505 1510 1515 1520
 Lys Asp Thr Ser His Ala Val Leu Lys Val Leu Ser Asn Ala Leu Ser
 1525 1530 1535
 His Pro Lys Ile Phe Lys Arg Phe Trp Asp Ala Gly Val Val Glu Pro
 1540 1545 1550
 Val Tyr Gly Pro Asn Leu Ser Asn Gln Asp Lys Ile Leu Leu Ala Ile
 1555 1560 1565
 Ser Val Cys Glu Tyr Ser Val Asp Leu Phe Met Arg Asp Trp Gln Glu
 1570 1575 1580
 Gly Ile Pro Leu Glu Ile Phe Ile Cys Asp Asn Asp Pro Asn Ile Ala
 1585 1590 1595 1600
 Glu Met Arg Lys Leu Ser Phe Leu Ala Arg His Leu Ala Tyr Leu Cys
 1605 1610 1615
 Ser Leu Ala Glu Ile Ala Lys Glu Gly Pro Lys Leu Glu Ser Met Thr
 1620 1625 1630
 Ser Leu Glu Arg Leu Glu Ser Leu Lys Glu Tyr Leu Glu Leu Thr Phe
 1635 1640 1645
 Leu Asp Asp Pro Ile Leu Arg Tyr Ser Gln Leu Thr Gly Leu Val Ile
 1650 1655 1660
 Lys Ile Phe Pro Ser Thr Leu Thr Tyr Ile Arg Lys Ser Ser Ile Lys
 1665 1670 1675 1680
 Val Leu Arg Val Arg Gly Ile Gly Ile Pro Glu Val Leu Glu Asp Trp
 1685 1690 1695
 Asp Pro Asp Ala Asp Ser Met Leu Leu Asp Asn Ile Thr Ala Glu Val
 1700 1705 1710
 Gln His Asn Ile Pro Leu Lys Lys Asn Glu Arg Thr Pro Phe Trp Gly
 1715 1720 1725
 Leu Arg Val Ser Lys Ser Gln Val Leu Arg Leu Arg Gly Tyr Glu Glu
 1730 1735 1740
 Ile Lys Arg Glu Glu Arg Gly Arg Ser Gly Val Gly Leu Thr Leu Pro
 1745 1750 1755 1760
 Phe Asp Gly Arg Tyr Leu Ser His Gln Leu Arg Leu Phe Gly Ile Asn
 1765 1770 1775
 Ser Thr Ser Cys Leu Lys Ala Leu Glu Leu Thr Tyr Leu Leu Asn Pro
 1780 1785 1790
 Leu Val Asn Lys Asp Lys Asp Arg Leu Tyr Leu Gly Glu Gly Ala Gly
 1795 1800 1805
 Ala Met Leu Ser Cys Tyr Asp Ala Thr Leu Gly Pro Cys Met Asn Tyr
 1810 1815 1820
 Tyr Asn Ser Gly Val Asn Ser Cys Asp Leu Asn Gly Gln Arg Glu Leu

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1825          1830          1835          1840
Asn Ile Tyr Pro Ser Glu Val Ala Leu Val Gly Lys Lys Leu Asn Asn
          1845          1850          1855
Val Thr Ser Leu Cys Gln Arg Val Lys Val Leu Phe Asn Gly Asn Pro
          1860          1865          1870
Gly Ser Thr Trp Ile Gly Asn Asp Glu Cys Glu Thr Leu Ile Trp Asn
          1875          1880          1885
Glu Leu Gln Asn Asn Ser Ile Gly Phe Ile His Cys Asp Met Glu Gly
          1890          1895          1900
Gly Glu His Lys Cys Asp Gln Val Val Leu His Glu His Tyr Ser Val
1905          1910          1915          1920
Ile Arg Ile Ala Tyr Leu Val Gly Asp Lys Asp Val Ile Leu Val Ser
          1925          1930          1935
Lys Ile Ala Pro Arg Leu Gly Thr Asp Trp Thr Lys Gln Leu Ser Leu
          1940          1945          1950
Tyr Leu Arg Tyr Trp Arg Asp Val Ser Leu Ile Val Leu Lys Thr Ser
          1955          1960          1965
Asn Pro Ala Ser Thr Glu Met Tyr Leu Ile Ser Lys Asp Pro Lys Ser
          1970          1975          1980
Asp Ile Ile Glu Asp Ser Asn Thr Val Leu Ala Asn Leu Leu Pro Leu
1985          1990          1995          2000
Ser Lys Glu Asp Ser Ile Lys Ile Glu Lys Trp Ile Leu Val Glu Lys
          2005          2010          2015
Ala Lys Val His Asp Trp Ile Val Arg Glu Leu Lys Glu Gly Ser Ala
          2020          2025          2030
Ser Ser Gly Met Leu Arg Pro Tyr His Gln Ala Leu Gln Ile Phe Gly
          2035          2040          2045
Phe Glu Pro Asn Leu Asn Lys Leu Cys Arg Asp Phe Leu Ser Thr Leu
          2050          2055          2060
Asn Ile Val Asp Thr Lys Asn Cys Ile Ile Thr Phe Asp Arg Val Leu
2065          2070          2075          2080
Arg Asp Thr Ile Phe Glu Trp Thr Arg Ile Lys Asp Ala Asp Lys Lys
          2085          2090          2095
Leu Arg Leu Thr Gly Lys Tyr Asp Leu Tyr Pro Leu Arg Asp Ser Gly
          2100          2105          2110
Lys Leu Lys Val Ile Ser Arg Arg Leu Val Ile Ser Trp Ile Ala Leu
          2115          2120          2125
Ser Met Ser Thr Arg Leu Val Thr Gly Ser Phe Pro Asp Ile Lys Phe
          2130          2135          2140
Glu Ser Arg Leu Gln Leu Gly Ile Val Ser Ile Ser Ser Arg Glu Ile
2145          2150          2155          2160
Lys Asn Leu Arg Val Ile Ser Lys Ile Val Ile Asp Lys Phe Glu Asp
          2165          2170          2175
Ile Ile His Ser Val Thr Tyr Arg Phe Leu Thr Lys Glu Ile Lys Ile
          2180          2185          2190
Leu Met Lys Ile Leu Gly Ala Val Lys Leu Phe Gly Ala Arg Gln Ser
          2195          2200          2205
Thr Ser Ala Asp Ile Thr Asn Ile Asp Thr Ser Asp Ser Ile Gln
          2210          2215          2220

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<210> 409

<211> 575

<212> PRT

<213> Human parainfluenza virus 1 strain Washington/1964

<220>

<223> HN glycoprotein of Human parainfluenza 1 virus

<400> 409

Met Ala Glu Lys Gly Lys Thr Asn Ser Ser Tyr Trp Ser Thr Thr Arg

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Asn Asp Asn Ser Thr Val Asn Thr His Ile Asn Thr Pro Ala Gly Arg			
	20	25	30
Thr His Ile Trp Leu Leu Ile Ala Thr Thr Met His Thr Val Leu Ser			
	35	40	45
Phe Ile Ile Met Ile Leu Cys Ile Asp Leu Ile Ile Lys Gln Asp Thr			
	50	55	60
Cys Met Lys Thr Asn Ile Met Thr Val Ser Ser Met Asn Glu Ser Ala			
65	70	75	80
Lys Ile Ile Lys Glu Thr Ile Thr Glu Leu Ile Arg Gln Glu Val Ile			
	85	90	95
Ser Arg Thr Ile Asn Ile Gln Ser Ser Val Gln Ser Gly Ile Pro Ile			
	100	105	110
Leu Leu Asn Lys Gln Ser Arg Asp Leu Thr Gln Leu Ile Glu Lys Ser			
	115	120	125
Cys Asn Arg Gln Glu Leu Ala Gln Ile Cys Glu Asn Thr Ile Ala Ile			
	130	135	140
His His Ala Asp Gly Ile Ser Pro Leu Asp Pro His Asp Phe Trp Arg			
145	150	155	160
Cys Pro Val Gly Glu Pro Leu Leu Ser Asn Asn Pro Asn Ile Ser Leu			
	165	170	175
Leu Pro Gly Pro Ser Leu Leu Ser Gly Ser Thr Thr Ile Ser Gly Cys			
	180	185	190
Val Arg Leu Pro Ser Leu Ser Ile Gly Asp Ala Ile Tyr Ala Tyr Ser			
	195	200	205
Ser Asn Leu Ile Thr Gln Gly Cys Ala Asp Ile Gly Lys Ser Tyr Gln			
	210	215	220
Val Leu Gln Leu Gly Tyr Ile Ser Leu Asn Ser Asp Met Tyr Pro Asp			
225	230	235	240
Leu Asn Pro Val Ile Ser His Thr Tyr Asp Ile Asn Asp Asn Arg Lys			
	245	250	255
Ser Cys Ser Val Ile Ala Ala Gly Thr Arg Gly Tyr Gln Leu Cys Ser			
	260	265	270
Leu Pro Thr Val Asn Glu Thr Thr Asp Tyr Ser Ser Glu Gly Ile Glu			
	275	280	285
Asp Leu Val Phe Asp Ile Leu Asp Leu Lys Gly Lys Thr Lys Ser His			
	290	295	300
Arg Tyr Lys Asn Glu Asp Ile Thr Phe Asp His Pro Phe Ser Ala Met			
305	310	315	320
Tyr Pro Ser Val Gly Ser Gly Ile Lys Ile Glu Asn Thr Leu Ile Phe			
	325	330	335
Leu Gly Tyr Gly Gly Leu Thr Thr Pro Leu Gln Gly Asp Thr Lys Cys			
	340	345	350
Val Ile Asn Arg Cys Thr Asn Val Asn Gln Ser Val Cys Asn Asp Ala			
	355	360	365
Leu Lys Ile Thr Trp Leu Lys Lys Arg Gln Val Val Asn Val Leu Ile			
	370	375	380
Arg Ile Asn Asn Tyr Leu Ser Asp Arg Pro Lys Ile Val Val Glu Thr			
385	390	395	400
Ile Pro Ile Thr Gln Asn Tyr Leu Gly Ala Glu Gly Arg Leu Leu Lys			
	405	410	415
Leu Gly Lys Lys Ile Tyr Ile Tyr Thr Arg Ser Ser Gly Trp His Ser			
	420	425	430
Asn Leu Gln Ile Gly Ser Leu Asp Ile Asn Asn Pro Met Thr Ile Lys			
	435	440	445
Trp Ala Pro His Glu Val Leu Ser Arg Pro Gly Asn Gln Asp Cys Asn			
	450	455	460
Trp Tyr Asn Arg Cys Pro Arg Glu Cys Ile Ser Gly Val Tyr Thr Asp			
465	470	475	480
Ala Tyr Pro Leu Ser Pro Asp Ala Val Asn Val Ala Thr Thr Thr Leu			
	485	490	495

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Tyr Ala Asn Thr Ser Arg Val Asn Pro Thr Ile Met Tyr Ser Asn Thr
      500                      505                      510
Ser Glu Ile Ile Asn Met Leu Arg Leu Lys Asn Val Gln Leu Glu Ala
      515                      520                      525
Ala Tyr Thr Thr Thr Ser Cys Ile Thr His Phe Gly Lys Gly Tyr Cys
      530                      535                      540
Phe His Ile Val Glu Ile Asn Gln Ala Ser Leu Asn Thr Leu Gln Pro
545                      550                      555                      560
Met Leu Phe Lys Thr Ser Ile Pro Lys Ile Cys Lys Ile Thr Ser
      565                      570                      575

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<210> 410

<211> 348

<212> PRT

<213> Human parainfluenza virus 1 strain Washington/1964

<220>

<223> matrix protein of Human parainfluenza 1 virus

<400> 410

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Met Ala Glu Thr Tyr Arg Phe Pro Arg Phe Ser His Glu Glu Asn Gly
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Thr Val Glu Pro Leu Pro Leu Lys Thr Gly Pro Asp Lys Lys Ala Ile
      20      25      30
Pro His Ile Arg Ile Val Lys Val Gly Asp Pro Pro Lys His Gly Val
      35      40      45
Arg Tyr Leu Asp Val Leu Leu Leu Gly Phe Phe Glu Thr Pro Lys Gln
      50      55      60
Gly Pro Leu Ser Gly Ser Ile Ser Asp Leu Thr Glu Ser Thr Ser Tyr
65      70      75      80
Ser Ile Cys Gly Ser Gly Ser Leu Pro Ile Gly Ile Ala Lys Tyr Tyr
      85      90      95
Gly Thr Asp Gln Glu Leu Leu Lys Ala Cys Ile Asp Leu Lys Ile Thr
      100     105     110
Val Arg Arg Thr Val Arg Ser Gly Glu Met Ile Val Tyr Met Val Asp
      115     120     125
Ser Ile His Ala Pro Leu Leu Pro Trp Ser Ser Arg Leu Arg Gln Gly
      130     135     140
Met Ile Tyr Asn Ala Asn Lys Val Ala Leu Ala Pro Gln Cys Leu Pro
145     150     155     160
Val Asp Lys Asp Ile Arg Phe Arg Val Val Phe Val Asn Gly Thr Ser
      165     170     175
Leu Gly Thr Ile Thr Ile Ala Lys Val Pro Lys Thr Leu Ala Asp Leu
      180     185     190
Ala Leu Pro Asn Ser Ile Ser Val Asn Leu Leu Val Thr Leu Arg Ala
      195     200     205
Gly Val Ser Thr Glu Gln Lys Gly Ile Leu Pro Val Leu Asp Asp Asp
      210     215     220
Gly Glu Lys Lys Leu Asn Phe Met Val His Leu Gly Ile Ile Arg Arg
225     230     235     240
Lys Val Gly Lys Ile Tyr Ser Val Glu Tyr Cys Lys Asn Lys Ile Glu
      245     250     255
Lys Met Lys Leu Ile Phe Ser Leu Gly Leu Val Gly Gly Ile Ser Phe
      260     265     270
His Val His Ala Thr Gly Thr Leu Ser Lys Thr Leu Met Ser Gln Leu
      275     280     285
Ala Trp Lys Lys Ala Val Cys Tyr Pro Leu Met Asp Val Asn Pro His
      290     295     300
Met Asn Leu Val Ile Trp Ala Ala Ser Val Glu Ile Thr Ser Val Asp
305     310     315     320

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Ala Val Phe Gln Pro Ala Ile Pro Lys Glu Phe Arg Tyr Tyr Pro Asn
 325 330 335
 Val Val Ala Lys Ser Ile Gly Lys Ile Arg Arg Ile
 340 345

<210> 411
 <211> 181
 <212> PRT
 <213> Human parainfluenza virus 1 strain Washington/1964

<220>
 <223> Y1 protein of Human parainfluenza 1 virus

<400> 411
 Met Ser Ser Asp Ser Leu Thr Ser Ser Tyr Pro Thr Ser Pro Gln Lys
 1 5 10 15
 Leu Glu Lys Thr Glu Ala Gly Ser Met Val Ser Ser Thr Thr Gln Lys
 20 25 30
 Lys Thr Ser His His Ala Lys Pro Thr Ile Thr Thr Lys Thr Glu Gln
 35 40 45
 Ser Gln Arg Arg Pro Lys Ile Ile Asp Gln Val Arg Gly Val Glu Ser
 50 55 60
 Leu Gly Glu Gln Val Ser Gln Lys Gln Arg His Met Leu Glu Ser Leu
 65 70 75 80
 Ile Asn Lys Val Tyr Thr Gly Pro Leu Gly Glu Glu Leu Val Gln Thr
 85 90 95
 Leu Tyr Leu Arg Ile Trp Ala Met Lys Glu Thr Pro Glu Ser Thr Lys
 100 105 110
 Ile Leu Gln Met Arg Glu Asp Ile Arg Asp Gln Tyr Leu Arg Met Lys
 115 120 125
 Thr Glu Arg Trp Leu Arg Thr Leu Ile Arg Gly Lys Lys Thr Lys Leu
 130 135 140
 Arg Asp Phe Gln Lys Arg Tyr Glu Glu Val His Pro Tyr Leu Met Met
 145 150 155 160
 Glu Arg Val Glu Gln Ile Ile Met Glu Glu Ala Trp Lys Leu Ala Ala
 165 170 175
 His Ile Val Gln Glu
 180

<210> 412
 <211> 204
 <212> PRT
 <213> Human parainfluenza virus 1 strain Washington/1964

<220>
 <223> C protein of Human parainfluenza 1 virus

<400> 412
 Met Pro Ser Phe Leu Arg Gly Ile Leu Lys Pro Lys Glu Arg His His
 1 5 10 15
 Glu Asn Lys Asn His Ser Gln Met Ser Ser Asp Ser Leu Thr Ser Ser
 20 25 30
 Tyr Pro Thr Ser Pro Gln Lys Leu Glu Lys Thr Glu Ala Gly Ser Met
 35 40 45
 Val Ser Ser Thr Thr Gln Lys Lys Thr Ser His His Ala Lys Pro Thr
 50 55 60
 Ile Thr Thr Lys Thr Glu Gln Ser Gln Arg Arg Pro Lys Ile Ile Asp
 65 70 75 80
 Gln Val Arg Gly Val Glu Ser Leu Gly Glu Gln Val Ser Gln Lys Gln
 85 90 95
 Arg His Met Leu Glu Ser Leu Ile Asn Lys Val Tyr Thr Gly Pro Leu

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<210> 413
<211> 568
<212> PRT
<213> Human parainfluenza virus 1 strain Washington/1964

<220>
<223> phosphoprotein of Human parainfluenza 1 virus
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- 229 -


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Ser Pro Pro Thr Pro Glu His Asp Ala Thr Ala Asn Glu Glu Glu Thr
305          310          315          320
Ser Asn Thr Ser Val Asp Glu Met Ala Lys Leu Leu Val Ser Leu Gly
          325          330          335
Val Met Lys Ser Gln His Glu Phe Glu Leu Ser Arg Ser Ala Ser His
          340          345          350
Val Phe Ala Lys Arg Met Leu Lys Ser Ala Asn Tyr Lys Glu Met Thr
          355          360          365
Phe Asn Leu Cys Gly Met Leu Ile Ser Val Glu Lys Ser Leu Glu Asn
          370          375          380
Lys Val Glu Glu Asn Arg Thr Leu Leu Lys Gln Ile Gln Glu Glu Ile
385          390          395          400
Asn Ser Ser Arg Asp Leu His Lys Arg Phe Ser Glu Tyr Gln Lys Glu
          405          410          415
Gln Asn Ser Leu Met Met Ala Asn Leu Ser Thr Leu His Ile Ile Thr
          420          425          430
Asp Arg Gly Gly Lys Thr Gly Asn Pro Ser Asp Thr Thr Arg Ser Pro
          435          440          445
Ser Val Phe Thr Lys Gly Lys Asp Asn Lys Val Lys Lys Thr Arg Phe
          450          455          460
Asp Pro Ser Met Glu Ala Leu Gly Gly Gln Glu Phe Lys Pro Asp Leu
465          470          475          480
Ile Arg Glu Asp Glu Leu Arg Asp Asp Ile Lys Asn Pro Val Leu Glu
          485          490          495
Glu Asn Asn Asn Glu Pro Gln Ala Ser Asn Ala Ser Arg Leu Ile Pro
          500          505          510
Ser Thr Glu Lys His Thr Leu His Ser Leu Lys Leu Val Ile Glu Asn
          515          520          525
Ser Pro Leu Ser Arg Val Glu Lys Lys Ala Tyr Ile Lys Ser Leu Tyr
          530          535          540
Lys Cys Arg Thr Asn Gln Glu Val Lys Asn Val Met Glu Leu Phe Glu
545          550          555          560
Glu Asp Ile Asp Ser Leu Thr Asn
          565

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<210> 414

<211> 524

<212> PRT

<213> Human parainfluenza virus 1 strain Washington/1964

<220>

<223> nucleoprotein of Human parainfluenza 1 virus

<400> 414

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Met Ala Gly Leu Leu Ser Thr Phe Asp Thr Phe Ser Ser Arg Arg Ser
1          5          10          15
Glu Ser Ile Asn Lys Ser Gly Gly Gly Ala Ile Ile Pro Gly Gln Arg
          20          25          30
Ser Thr Val Ser Val Phe Thr Leu Gly Pro Ser Val Thr Asp Asp Ala
          35          40          45
Asp Lys Leu Leu Ile Ala Thr Thr Phe Leu Ala His Ser Leu Asp Thr
          50          55          60
Asp Lys Gln His Ser Gln Arg Gly Gly Phe Leu Val Ser Leu Leu Ala
65          70          75          80
Met Ala Tyr Ser Ser Pro Glu Leu Tyr Leu Thr Thr Asn Gly Val Asn
          85          90          95
Ala Asp Val Lys Tyr Val Ile Tyr Asn Ile Glu Arg Asp Pro Lys Arg
          100          105          110
Thr Lys Thr Asp Gly Phe Ile Val Lys Thr Arg Asp Met Glu Tyr Glu
          115          120          125
Arg Thr Thr Glu Trp Leu Phe Gly Pro Met Ile Asn Lys Asn Pro Leu

```

130						135					140				
Phe	Gln	Gly	Gln	Arg	Glu	Asn	Ala	Asp	Leu	Glu	Ala	Leu	Leu	Gln	Thr
145					150					155					160
Tyr	Gly	Tyr	Pro	Ala	Cys	Leu	Gly	Ala	Ile	Ile	Val	Gln	Val	Trp	Ile
				165					170					175	
Val	Leu	Val	Lys	Ala	Ile	Thr	Ser	Ser	Ala	Gly	Leu	Arg	Lys	Gly	Phe
			180					185					190		
Phe	Asn	Arg	Leu	Glu	Ala	Phe	Arg	Gln	Asp	Gly	Thr	Val	Lys	Ser	Ala
	195						200					205			
Leu	Val	Phe	Thr	Gly	Asp	Thr	Val	Glu	Gly	Ile	Gly	Ala	Val	Met	Arg
	210					215					220				
Ser	Gln	Gln	Ser	Leu	Val	Ser	Leu	Met	Val	Glu	Thr	Leu	Val	Thr	Met
225					230					235					240
Asn	Thr	Ser	Arg	Ser	Asp	Leu	Thr	Thr	Leu	Glu	Lys	Asn	Ile	Gln	Ile
				245					250					255	
Val	Gly	Asn	Tyr	Ile	Arg	Asp	Ala	Gly	Leu	Ala	Ser	Phe	Met	Asn	Thr
		260					265						270		
Ile	Lys	Tyr	Gly	Val	Glu	Thr	Lys	Met	Ala	Ala	Leu	Thr	Leu	Ser	Asn
	275						280						285		
Leu	Arg	Pro	Asp	Ile	Asn	Lys	Leu	Arg	Ser	Leu	Val	Asp	Ile	Tyr	Leu
	290				295						300				
Ser	Lys	Gly	Ala	Arg	Ala	Pro	Phe	Ile	Cys	Ile	Leu	Arg	Asp	Pro	Val
305					310					315					320
His	Gly	Asp	Phe	Ala	Pro	Gly	Asn	Tyr	Pro	Ala	Leu	Trp	Ser	Tyr	Ala
			325						330					335	
Met	Gly	Val	Ala	Val	Val	Gln	Asn	Lys	Ala	Met	Gln	Gln	Tyr	Val	Thr
		340						345					350		
Gly	Arg	Thr	Tyr	Leu	Asp	Met	Glu	Met	Phe	Leu	Leu	Gly	Gln	Ala	Val
	355					360						365			
Ala	Lys	Asp	Ala	Asp	Ser	Lys	Ile	Ser	Ser	Ala	Leu	Glu	Glu	Glu	Leu
	370					375					380				
Gly	Val	Thr	Asp	Thr	Ala	Lys	Glu	Arg	Leu	Arg	His	His	Leu	Thr	Asn
385					390					395					400
Leu	Ser	Gly	Gly	Asp	Gly	Ala	Tyr	His	Lys	Pro	Thr	Gly	Gly	Gly	Ala
			405						410					415	
Ile	Glu	Val	Ala	Ile	Asp	His	Thr	Asp	Ile	Thr	Phe	Gly	Val	Glu	Asp
		420						425					430		
Thr	Ala	Asp	Arg	Asp	Asn	Lys	Asn	Trp	Thr	Asn	Asp	Ser	Asn	Glu	Arg
	435						440					445			
Trp	Met	Asn	His	Ser	Ile	Ser	Asn	His	Thr	Ile	Thr	Ile	Arg	Gly	Ala
	450					455					460				
Glu	Glu	Leu	Glu	Glu	Glu	Thr	Asn	Asp	Glu	Asp	Ile	Thr	Asp	Ile	Glu
465					470				475						480
Asn	Lys	Ile	Ala	Arg	Arg	Leu	Ala	Asp	Arg	Lys	Gln	Arg	Leu	Ser	Gln
			485					490						495	
Ala	Asn	Asn	Lys	Arg	Asp	Thr	Ser	Ser	Asp	Ala	Asp	Tyr	Glu	Asn	Asp
	500						505						510		
Asp	Asp	Ala	Thr	Ala	Ala	Ala	Gly	Ile	Gly	Gly	Ile				
	515					520									

<210> 415

<211> 555

<212> PRT

<213> Human parainfluenza virus 1 strain Washington/1964

<220>

<223> F glycoprotein of Human parainfluenza 1 virus

<400> 415

Met	Gln	Lys	Ser	Glu	Ile	Leu	Phe	Leu	Val	Tyr	Ser	Ser	Leu	Leu	Leu
1				5					10				15		

Ser	Ser	Ser	Leu	Cys	Gln	Ile	Pro	Val	Glu	Lys	Leu	Ser	Asn	Val	Gly
			20					25					30		
Val	Ile	Ile	Asn	Glu	Gly	Lys	Leu	Leu	Lys	Ile	Ala	Gly	Ser	Tyr	Glu
		35					40					45			
Ser	Arg	Tyr	Ile	Val	Leu	Ser	Leu	Val	Pro	Ser	Ile	Asp	Leu	Gln	Asp
	50					55					60				
Gly	Cys	Gly	Thr	Thr	Gln	Ile	Ile	Gln	Tyr	Lys	Asn	Leu	Leu	Asn	Arg
	65				70				75					80	
Leu	Leu	Ile	Pro	Leu	Lys	Asp	Ala	Leu	Asp	Leu	Gln	Glu	Ser	Leu	Ile
				85					90					95	
Thr	Ile	Thr	Asn	Asp	Thr	Thr	Val	Thr	Asn	Asp	Asn	Pro	Gln	Thr	Arg
			100					105					110		
Phe	Phe	Gly	Ala	Val	Ile	Gly	Thr	Ile	Ala	Leu	Gly	Val	Ala	Thr	Ala
		115					120					125			
Ala	Gln	Ile	Thr	Ala	Gly	Ile	Ala	Leu	Ala	Glu	Ala	Arg	Glu	Ala	Arg
	130				135						140				
Lys	Asp	Ile	Ala	Leu	Ile	Lys	Asp	Ser	Ile	Val	Lys	Thr	His	Asn	Ser
	145				150					155					160
Val	Glu	Leu	Ile	Gln	Arg	Gly	Ile	Gly	Glu	Gln	Ile	Ile	Ala	Leu	Lys
			165					170						175	
Thr	Leu	Gln	Asp	Phe	Val	Asn	Asp	Glu	Ile	Arg	Pro	Ala	Ile	Gly	Glu
			180					185					190		
Leu	Arg	Cys	Glu	Thr	Thr	Ala	Leu	Lys	Leu	Gly	Ile	Lys	Leu	Thr	Gln
		195					200					205			
His	Tyr	Ser	Glu	Leu	Ala	Thr	Ala	Phe	Ser	Ser	Asn	Leu	Gly	Thr	Ile
	210					215					220				
Gly	Glu	Lys	Ser	Leu	Thr	Leu	Gln	Ala	Leu	Ser	Ser	Leu	Tyr	Ser	Ala
	225				230					235					240
Asn	Ile	Thr	Glu	Ile	Leu	Ser	Thr	Thr	Lys	Lys	Asp	Lys	Ser	Asp	Ile
			245					250						255	
Tyr	Asp	Ile	Ile	Tyr	Thr	Glu	Gln	Val	Lys	Gly	Thr	Val	Ile	Asp	Val
		260					265						270		
Asp	Leu	Glu	Lys	Tyr	Met	Val	Thr	Leu	Leu	Val	Lys	Ile	Pro	Ile	Leu
	275						280					285			
Ser	Glu	Ile	Pro	Gly	Val	Leu	Ile	Tyr	Arg	Ala	Ser	Ser	Ile	Ser	Tyr
	290					295					300				
Asn	Ile	Glu	Gly	Glu	Glu	Trp	His	Val	Ala	Ile	Pro	Asn	Tyr	Ile	Ile
	305				310					315					320
Asn	Lys	Ala	Ser	Ser	Leu	Gly	Gly	Ala	Asp	Val	Thr	Asn	Cys	Ile	Glu
			325					330						335	
Ser	Lys	Leu	Ala	Tyr	Ile	Cys	Pro	Arg	Asp	Pro	Thr	Gln	Leu	Ile	Pro
			340					345					350		
Asp	Asn	Gln	Gln	Lys	Cys	Ile	Leu	Gly	Asp	Val	Ser	Lys	Cys	Pro	Val
	355						360					365			
Thr	Lys	Val	Ile	Asn	Asn	Leu	Val	Pro	Lys	Phe	Ala	Phe	Ile	Asn	Gly
	370					375						380			
Gly	Val	Val	Ala	Asn	Cys	Ile	Ala	Ser	Thr	Cys	Thr	Cys	Gly	Thr	Asn
	385				390					395					400
Arg	Ile	Pro	Val	Asn	Gln	Asp	Arg	Ser	Arg	Gly	Val	Thr	Phe	Leu	Thr
				405					410					415	
Tyr	Thr	Asn	Cys	Gly	Leu	Ile	Gly	Ile	Asn	Gly	Ile	Glu	Leu	Tyr	Ala
		420					425						430		
Asn	Lys	Arg	Gly	Arg	Asp	Thr	Thr	Trp	Gly	Asn	Gln	Ile	Ile	Lys	Val
		435				440						445			
Gly	Pro	Ala	Val	Ser	Ile	Arg	Pro	Val	Asp	Ile	Ser	Leu	Asn	Leu	Ala
	450					455					460				
Ser	Ala	Thr	Asn	Phe	Leu	Glu	Glu	Ser	Lys	Thr	Glu	Leu	Met	Lys	Ala
	465				470					475					480
Arg	Ala	Ile	Ile	Ser	Ala	Val	Gly	Gly	Trp	His	Asn	Thr	Glu	Ser	Thr
				485				490						495	
Gln	Ile	Ile	Met	Ile	Ile	Ile	Val	Cys	Ile	Leu	Ile	Ile	Ile	Ile	Cys

<400>	416															
Met	Glu	Ser	Asp	Ala	Lys	Asn	Tyr	Gln	Ile	Met	Asp	Ser	Trp	Glu	Glu	
1				5					10					15		
Glu	Ser	Arg	Asp	Lys	Ser	Thr	Asn	Ile	Ser	Ser	Ala	Leu	Asn	Ile	Ile	
			20					25					30			
Glu	Phe	Ile	Leu	Ser	Thr	Asp	Pro	Gln	Glu	Asp	Leu	Ser	Glu	Asn	Asp	
		35					40					45				
Thr	Ile	Asn	Thr	Arg	Thr	Gln	Gln	Leu	Ser	Ala	Thr	Ile	Tyr	Gln	Pro	
	50					55					60					
Lys	Ile	Lys	Pro	Thr	Glu	Thr	Ser	Glu	Lys	Asp	Ser	Gly	Ser	Thr	Asp	
65					70					75					80	
Lys	Asn	Arg	Gln	Ser	Gly	Ser	Ser	His	Glu	Cys	Thr	Thr	Glu	Ala	Lys	
				85					90					95		
Asp	Arg	Thr	Ile	Asp	Gln	Glu	Thr	Val	Gln	Arg	Gly	Pro	Gly	Arg	Arg	
			100					105					110			
Ser	Ser	Ser	Asp	Ser	Arg	Ala	Glu	Thr	Val	Val	Ser	Gly	Gly	Ile	Ser	
		115					120					125				
Arg	Ser	Ile	Thr	Asn	Ser	Lys	Asn	Gly	Thr	Gln	Asn	Thr	Glu	Asp	Ile	
	130					135						140				
Asp	Leu	Asn	Glu	Ile	Arg	Lys	Met	Asp	Lys	Asp	Ser	Ile	Glu	Gly	Lys	
145					150					155					160	
Val	Arg	Gln	Ser	Ala	Asp	Val	Pro	Ser	Glu	Ile	Ser	Gly	Ser	Asp	Val	
				165					170					175		
Ile	Phe	Thr	Thr	Glu	Gln	Ser	Arg	Asn	Ser	Asp	His	Gly	Arg	Ser	Leu	
			180					185					190			
Glu	Ser	Ile	Ser	Thr	Pro	Asp	Thr	Arg	Ser	Ile	Ser	Val	Val	Thr	Ala	
		195					200					205				
Ala	Thr	Pro	Asp	Asp	Glu	Glu	Ile	Leu	Met	Lys	Asn	Ser	Arg	Thr		
	210					215					220					
Lys	Lys	Ser	Ser	Ser	Ile	His	Gln	Glu	Asp	Asp	Lys	Arg	Ile	Lys	Lys	
225					230					235					240	
Gly	Gly	Glu	Lys	Gly	Lys	Thr	Gly	Leu	Arg	Asn	Gln	Lys	Ile	Leu	Thr	
				245					250					255		
Thr	Arg	Tyr	Gln	His	Gln	Thr	Thr	Asp	Pro	His	Gln	Lys	Gly	Arg	Arg	
			260					265					270			
Lys	Ser	Gln	Lys	Gln	Gln	Pro	Ser	Thr	Pro	Thr	Gln	Arg	Gly	Lys	Gln	
		275					280					285				
Lys	Tyr	Arg	Gln	Asn	His	Gln	Glu	His	Asn	Pro	His	His	Gly	Ile	Ser	
	290					295					300					
Pro	Leu	Ile	Thr	Thr	Gln	Ile	Glu	Pro	Asn	Arg	Gln	Thr	Gln	Leu	Pro	
305					310					315					320	
Gln	Gln	Gln	Pro	Pro												

Arg Ile Gln Lys Arg Ala Ile Asp Leu Gln Arg Gly Gln Leu Leu Tyr
 355 360 365
 Cys Arg Ile Leu Val
 370

<210> 417
 <211> 574
 <212> PRT
 <213> Human parainfluenza virus 3

<220>
 <223> hemagglutinin-neuraminidase of Human parainfluenza virus 3

<400> 417
 Met Glu Tyr Trp Lys His Thr Asn His Gly Lys Asp Ala Gly Asn Glu
 1 5 10 15
 Leu Glu Thr Ser Met Ala Thr His Asn Lys Leu Thr Asn Lys Ile
 20 25 30
 Ile Tyr Ile Leu Trp Thr Ile Ile Leu Val Leu Leu Ser Ile Val Phe
 35 40 45
 Ile Ile Val Leu Ile Asn Ser Ile Asn Ser Glu Lys Val His Asn Ser
 50 55 60
 Leu Leu Gln Glu Ile Asn Asn Glu Phe Met Glu Ile Thr Glu Lys Ile
 65 70 75 80
 Gln Met Ala Ser Asp Asn Thr Asn Asp Leu Ile Gln Ser Gly Val Asn
 85 90 95
 Thr Arg Leu Leu Thr Ile Gln Ser His Val Gln Asn Tyr Ile Pro Ile
 100 105 110
 Ser Leu Thr Gln Gln Met Ser Asp Leu Arg Lys Phe Ile Ser Glu Ile
 115 120 125
 Thr Ile Arg Asn Asp Asn Gln Glu Val Pro Gln Gln Arg Ile Thr His
 130 135 140
 Asp Val Gly Ile Lys Pro Leu Asn Pro Asp Asp Phe Trp Arg Cys Thr
 145 150 155 160
 Ser Gly Leu Pro Phe Leu Met Arg Asn Pro Lys Ile Arg Leu Met Pro
 165 170 175
 Gly Pro Gly Leu Leu Ala Met Pro Thr Thr Val Asp Gly Cys Val Arg
 180 185 190
 Thr Pro Ser Leu Ile Ile Asn Asp Leu Ile Tyr Ala Tyr Thr Ser Asn
 195 200 205
 Leu Ile Thr Arg Gly Cys Gln Asp Ile Gly Lys Ser Tyr Gln Val Leu
 210 215 220
 Gln Val Gly Ile Ile Thr Val Asn Ser Asp Leu Val Pro Asp Leu Asn
 225 230 235 240
 Pro Arg Phe Ser His Thr Phe Asn Ile Asn Asp Asn Arg Lys Ser Cys
 245 250 255
 Ser Leu Ala Leu Leu Asn Thr Asp Val Tyr Gln Leu Cys Ser Thr Pro
 260 265 270
 Lys Val Asp Glu Arg Ser Asp Tyr Ala Ser Ser Gly Ile Glu Asp Ile
 275 280 285
 Val Leu Asp Ile Val Asn Tyr Asp Gly Ser Ile Ser Thr Thr Arg Phe
 290 295 300
 Lys Asn Asn Asn Ile Ser Phe Asp Gln Pro Tyr Ala Ala Leu Tyr Pro
 305 310 315 320
 Ser Val Gly Pro Gly Ile Tyr Tyr Lys Gly Lys Ile Ile Phe Leu Gly
 325 330 335
 Tyr Gly Gly Leu Glu His Pro Ile Asn Glu Asn Val Ile Cys Asn Thr
 340 345 350
 Thr Glu Cys Pro Gly Lys Thr Gln Arg Asp Cys Asn Gln Ala Ser Tyr
 355 360 365
 Ser Pro Trp Phe Ser Asp Arg Arg Met Val Asn Ser Ile Ile Val Val

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      370                      375                      380
Asp Lys Gly Leu Asn Ser Ile Pro Lys Leu Lys Val Trp Thr Ile Ser
385                      390                      395                      400
Met Arg Gln Asn Tyr Trp Gly Ser Glu Gly Arg Leu Ile Leu Leu Gly
      405                      410                      415
Asn Lys Ile Tyr Ile Tyr Thr Arg Ser Thr Ser Trp His Ser Lys Leu
      420                      425                      430
Gln Leu Gly Ile Ile Asp Ile Thr Asp Tyr Ser Asp Ile Arg Ile Lys
      435                      440                      445
Trp Thr Trp His Asn Val Leu Ser Arg Pro Gly Asn Asp Glu Cys Pro
      450                      455                      460
Trp Gly His Ser Cys Pro Asn Gly Cys Ile Thr Gly Val Tyr Thr Asp
465                      470                      475                      480
Ala Tyr Pro Leu Asn Pro Thr Gly Ser Ile Val Ser Ser Val Ile Leu
      485                      490                      495
Asp Ser Gln Lys Ser Arg Val Asn Pro Val Ile Thr Tyr Ser Thr Ala
      500                      505                      510
Thr Glu Arg Val Asn Glu Leu Ala Ile Arg Asn Arg Thr Leu Ser Ala
      515                      520                      525
Gly Tyr Thr Thr Thr Ser Cys Ile Thr His Tyr Asp Lys Gly Tyr Cys
      530                      535                      540
Phe His Ile Val Glu Ile Asn Gln Lys Ser Ser Asn Thr Phe Gln Pro
545                      550                      555                      560
Met Leu Phe Lys Thr Glu Ile Pro Lys Ser Cys Ser Gln Ser
      565                      570

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<210> 418

<211> 515

<212> PRT

<213> Human parainfluenza virus 3

<220>

<223> nucleocapsid protein of Human parainfluenza virus 3

<400> 418

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Met Leu Ser Leu Phe Asp Thr Phe Asn Ala Arg Arg Gln Glu Asn Ile
1                      5                      10                      15
Thr Lys Ser Ala Gly Gly Ala Ile Ile Pro Gly Gln Lys Asn Thr Val
      20                      25                      30
Ser Ile Phe Ala Leu Gly Pro Thr Ile Thr Asp Asp Asn Glu Lys Met
      35                      40                      45
Thr Leu Ala Leu Leu Phe Leu Ser His Ser Leu Asp Asn Glu Lys Gln
      50                      55                      60
His Ala Gln Arg Ala Gly Phe Leu Val Ser Leu Leu Ser Met Ala Tyr
65                      70                      75                      80
Ala Asn Pro Glu Leu Tyr Leu Thr Thr Asn Gly Ser Asn Ala Asp Val
      85                      90                      95
Lys Tyr Val Ile Tyr Met Ile Glu Lys Asp Leu Lys Arg Gln Lys Tyr
      100                      105                      110
Gly Gly Phe Val Val Lys Thr Arg Glu Met Val Tyr Asp Lys Thr Thr
      115                      120                      125
Asp Trp Ile Phe Gly Ser Asp Leu Asp Cys Asp Gln Glu Thr Met Leu
130                      135                      140
Gln Asn Gly Arg Asn Asn Ser Thr Ile Glu Asp Leu Val His Thr Phe
145                      150                      155                      160
Gly Tyr Pro Ser Cys Leu Gly Ala Leu Ile Ile Gln Ile Trp Ile Val
      165                      170                      175
Leu Val Lys Ala Ile Thr Ser Ile Ser Gly Leu Arg Lys Gly Phe Phe
      180                      185                      190
Thr Arg Leu Glu Ala Phe Arg Gln Asp Gly Thr Val Gln Ala Gly Leu

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      195              200              205
Val Leu Ser Gly Asp Thr Val Asp Gln Ile Gly Ser Ile Met Arg Ser
  210              215              220
Gln Gln Ser Leu Val Thr Leu Met Val Glu Thr Leu Ile Thr Met Asn
  225              230              235              240
Thr Ser Arg Asn Asp Leu Thr Thr Ile Glu Lys Asn Ile Gln Ile Val
      245              250              255
Gly Asn Tyr Ile Arg Asp Ala Gly Leu Ala Ser Phe Phe Asn Thr Ile
      260              265              270
Arg Tyr Gly Ile Glu Thr Arg Met Ala Ala Leu Thr Leu Ser Thr Leu
      275              280              285
Arg Pro Asp Ile Asn Arg Leu Lys Ala Leu Met Glu Leu Tyr Leu Ser
      290              295              300
Lys Gly Pro Arg Ala Pro Phe Ile Cys Ile Leu Arg Asp Pro Ile His
  305              310              315              320
Gly Glu Phe Ala Pro Gly Asn Tyr Pro Ala Ile Trp Ser Tyr Ala Met
      325              330              335
Gly Val Ala Val Val Gln Asn Arg Ala Met Gln Gln Tyr Val Thr Gly
      340              345              350
Arg Ser Tyr Leu Asp Ile Asp Met Phe Gln Leu Gly Gln Ala Val Ala
      355              360              365
Arg Asp Ala Glu Ala Gln Met Ser Ser Thr Leu Glu Asp Glu Leu Gly
      370              375              380
Val Thr His Glu Ala Lys Glu Ser Leu Lys Arg His Ile Arg Asn Ile
  385              390              395              400
Asn Ser Ser Glu Thr Ser Phe His Lys Pro Thr Gly Gly Ser Ala Ile
      405              410              415
Glu Met Ala Ile Asp Glu Glu Pro Glu Gln Phe Glu His Arg Ser Asp
      420              425              430
Gln Glu Arg Asp Gly Glu Pro Gln Ser Ser Ile Ile Gln Tyr Ala Trp
      435              440              445
Ala Glu Gly Asn Arg Ser Asp Asp Arg Thr Glu Gln Asp Thr Glu Ser
      450              455              460
Asp Asn Ile Lys Thr Glu Gln Gln Asn Ile Arg Asp Arg Leu Asn Lys
  465              470              475              480
Arg Leu Asn Glu Lys Lys Gln Gly Ser Gln Pro Pro Thr Asn Pro
      485              490              495
Thr Asn Arg Thr Asn Gln Asp Glu Ile Asp Asp Leu Phe Asn Ala Phe
      500              505              510
Gly Ser Asn
      515

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<210> 419

<211> 395

<212> PRT

<213> Human parainfluenza virus 2

<220>

<223> P protein of Human parainfluenza virus 2

<400> 419

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Met Ala Glu Glu Pro Thr Tyr Thr Thr Glu Gln Val Asp Glu Leu Ile
  1              5              10              15
His Ala Gly Leu Gly Thr Val Asp Phe Phe Leu Ser Arg Pro Ile Asp
      20              25              30
Ala Gln Ser Ser Leu Gly Lys Gly Ser Ile Pro Pro Gly Val Thr Ala
      35              40              45
Val Leu Thr Ser Ala Ala Glu Thr Lys Ser Lys Pro Val Ala Ala Gly
      50              55              60
Pro Val Lys Pro Arg Arg Lys Lys Val Ile Ser Asn Thr Thr Pro Tyr

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65          70          75          80
Thr Ile Ala Asp Asn Ile Pro Pro Glu Lys Leu Pro Ile Asn Thr Pro
      85          90          95
Ile Pro Asn Pro Leu Leu Pro Leu Ala Arg Pro His Gly Lys Met Thr
      100        105        110
Asp Ile Asp Ile Val Thr Gly Asn Ile Thr Glu Gly Ser Tyr Lys Gly
      115        120        125
Val Glu Leu Ala Lys Leu Gly Lys Gln Thr Leu Leu Thr Arg Phe Thr
      130        135        140
Ser Asn Glu Pro Val Ser Ser Ala Gly Ser Ala Gln Asp Pro Asn Phe
      145        150        155
Lys Arg Gly Gly Glu Leu Ile Glu Lys Glu Gln Glu Ala Thr Ile Gly
      165        170        175
Glu Asn Gly Val Leu His Gly Ser Glu Ile Arg Ser Lys Ser Ser Ser
      180        185        190
Gly Val Ile Pro Gly Val Pro Gln Ser Arg Pro Gln Leu Ala Ser Ser
      195        200        205
Pro Ala His Ala Asp Pro Ala Pro Ala Ser Ala Glu Asn Val Lys Glu
      210        215        220
Ile Ile Glu Leu Leu Lys Gly Leu Asp Leu Arg Leu Gln Thr Val Glu
      225        230        235
Gly Lys Val Asp Lys Ile Leu Ala Thr Ser Ala Thr Ile Ile Asn Leu
      245        250        255
Lys Asn Glu Met Thr Ser Leu Lys Ala Ser Val Ala Thr Met Glu Gly
      260        265        270
Met Ile Thr Thr Ile Lys Ile Met Asp Pro Ser Thr Pro Thr Asn Val
      275        280        285
Pro Val Glu Glu Ile Arg Lys Ser Leu His Asn Val Pro Val Val Ile
      290        295        300
Ala Gly Pro Thr Ser Gly Gly Phe Thr Ala Glu Gln Val Ile Leu Ile
      305        310        315
Ser Met Asp Glu Leu Ala Arg Pro Thr Leu Ser Ser Thr Lys Arg Ile
      325        330        335
Thr Arg Lys Pro Glu Ser Lys Lys Asp Leu Thr Gly Ile Lys Leu Thr
      340        345        350
Leu Met Gln Leu Ala Asn Asp Cys Ile Ser Arg Pro Asp Thr Lys Thr
      355        360        365
Glu Phe Val Thr Lys Ile Gln Ala Ala Thr Thr Glu Ser Gln Leu Asn
      370        375        380
Glu Ile Lys Arg Ser Ile Ile Arg Ser Ala Ile
      385        390        395

```

<210> 420

<211> 539

<212> PRT

<213> Human parainfluenza virus

<220>

<223> F protein of Human parainfluenza virus

<400> 420

```

Met Ser Trp Lys Val Val Ile Ile Phe Ser Leu Leu Ile Thr Pro Gln
1          5          10          15
His Gly Leu Lys Glu Ser Tyr Leu Glu Glu Ser Cys Ser Thr Ile Thr
      20          25          30
Glu Gly Tyr Leu Ser Val Leu Arg Thr Gly Trp Tyr Thr Asn Val Phe
      35          40          45
Thr Leu Glu Val Gly Asp Val Glu Asn Leu Thr Cys Ala Asp Gly Pro
      50          55          60
Ser Leu Ile Lys Thr Glu Leu Asp Leu Thr Lys Ser Ala Leu Arg Glu

```


65					70					75					80
Leu	Arg	Thr	Val	Ser	Ala	Asp	Gln	Leu	Ala	Arg	Glu	Glu	Gln	Ile	Glu
				85					90					95	
Asn	Pro	Arg	Gln	Ser	Arg	Phe	Val	Leu	Gly	Ala	Ile	Ala	Leu	Gly	Val
			100					105					110		
Ala	Thr	Ala	Ala	Ala	Val	Thr	Ala	Gly	Val	Ala	Ile	Ala	Lys	Thr	Ile
			115				120					125			
Arg	Leu	Glu	Ser	Glu	Val	Thr	Ala	Ile	Lys	Asn	Ala	Leu	Lys	Lys	Thr
	130					135					140				
Asn	Glu	Ala	Val	Ser	Thr	Leu	Gly	Asn	Gly	Val	Arg	Val	Leu	Ala	Thr
145					150					155					160
Ala	Val	Arg	Glu	Leu	Lys	Asp	Phe	Val	Ser	Lys	Asn	Leu	Thr	Arg	Ala
				165				170						175	
Ile	Asn	Lys	Asn	Lys	Cys	Asp	Ile	Ala	Asp	Leu	Lys	Met	Ala	Val	Ser
			180					185					190		
Phe	Ser	Gln	Phe	Asn	Arg	Arg	Phe	Leu	Asn	Val	Val	Arg	Gln	Phe	Ser
	195						200					205			
Asp	Asn	Ala	Gly	Ile	Thr	Pro	Ala	Ile	Ser	Leu	Asp	Leu	Met	Thr	Asp
	210				215						220				
Ala	Glu	Leu	Ala	Arg	Ala	Val	Ser	Asn	Met	Pro	Thr	Ser	Ala	Gly	Gln
225					230					235					240
Ile	Lys	Leu	Met	Leu	Glu	Asn	Arg	Ala	Met	Val	Arg	Arg	Lys	Gly	Phe
			245					250						255	
Gly	Phe	Leu	Ile	Gly	Val	Tyr	Gly	Ser	Ser	Val	Ile	Tyr	Met	Val	Gln
			260				265							270	
Leu	Pro	Ile	Phe	Gly	Val	Ile	Asp	Thr	Pro	Cys	Trp	Ile	Val	Lys	Ala
	275						280					285			
Ala	Pro	Ser	Cys	Ser	Gly	Lys	Lys	Gly	Asn	Tyr	Ala	Cys	Leu	Leu	Arg
	290				295						300				
Glu	Asp	Gln	Gly	Trp	Tyr	Cys	Gln	Asn	Ala	Gly	Ser	Thr	Val	Tyr	Tyr
305					310					315					320
Pro	Asn	Glu	Lys	Asp	Cys	Glu	Thr	Arg	Gly	Asp	His	Val	Phe	Cys	Asp
				325					330					335	
Thr	Ala	Ala	Gly	Ile	Asn	Val	Ala	Glu	Gln	Ser	Lys	Glu	Cys	Asn	Ile
			340					345					350		
Asn	Ile	Ser	Thr	Thr	Asn	Tyr	Pro	Cys	Lys	Val	Ser	Thr	Gly	Arg	His
	355					360						365			
Pro	Ile	Ser	Met	Val	Ala	Leu	Ser	Pro	Leu	Gly	Ala	Leu	Val	Ala	Cys
	370					375					380				
Tyr	Lys	Gly	Val	Ser	Cys	Ser	Ile	Gly	Ser	Asn	Arg	Val	Gly	Ile	Ile
385					390					395					400
Lys	Gln	Leu	Asn	Lys	Gly	Cys	Ser	Tyr	Ile	Thr	Asn	Gln	Asp	Ala	Asp
			405						410					415	
Thr	Val	Thr	Ile	Asp	Asn	Thr	Val	Tyr	Gln	Leu	Ser	Lys	Val	Glu	Gly
			420					425					430		
Glu	Gln	His	Val	Ile	Lys	Gly	Arg	Pro	Val	Ser	Ser	Ser	Phe	Asp	Pro
			435				440					445			
Val	Lys	Phe	Pro	Glu	Asp	Gln	Phe	Asn	Val	Ala	Leu	Asp	Gln	Val	Phe
	450					455					460				
Glu	Ser	Ile	Glu	Asn	Ser	Gln	Ala	Leu	Val	Asp	Gln	Ser	Asn	Arg	Ile
465					470					475					480
Leu	Ser	Ser	Ala	Glu	Lys	Gly	Asn	Thr	Gly	Phe	Ile	Ile	Val	Ile	Ile
				485					490					495	
Leu	Ile	Ala	Val	Leu	Gly	Ser	Thr	Met	Ile	Leu	Val	Ser	Val	Phe	Ile
			500					505					510		
Ile	Ile	Lys	Lys	Thr	Lys	Lys	Pro	Thr	Gly	Ala	Pro	Pro	Glu	Leu	Ser
		515					520					525			
Gly	Val	Thr	Asn	Asn	Gly	Phe	Ile	Pro	His	Asn					
	530					535									

<210> 421
 <211> 236
 <212> PRT
 <213> Human parainfluenza virus

<220>
 <223> G protein of Human parainfluenza virus

<400> 421
 Met Glu Val Lys Val Glu Asn Ile Arg Thr Ile Asp Met Leu Lys Ala
 1 5 10 15
 Arg Val Lys Asn Arg Val Ala Arg Ser Lys Cys Phe Lys Asn Ala Ser
 20 25 30
 Leu Val Leu Ile Gly Ile Thr Thr Leu Ser Ile Ala Leu Asn Ile Tyr
 35 40 45
 Leu Ile Ile Asn Tyr Lys Met Gln Lys Asn Thr Ser Glu Ser Glu His
 50 55 60
 His Thr Ser Ser Ser Pro Met Glu Ser Ser Arg Glu Thr Pro Thr Val
 65 70 75 80
 Pro Thr Asp Asn Ser Asp Thr Asn Ser Ser Pro Gln His Pro Thr Gln
 85 90 95
 Gln Ser Thr Glu Gly Ser Thr Leu Tyr Phe Ala Ala Ser Ala Ser Ser
 100 105 110
 Pro Glu Thr Glu Pro Thr Ser Thr Pro Asp Thr Thr Asn Arg Pro Pro
 115 120 125
 Phe Val Asp Thr His Thr Thr Pro Pro Ser Ala Ser Arg Thr Lys Thr
 130 135 140
 Ser Pro Ala Val His Thr Lys Asn Asn Pro Arg Thr Ser Ser Arg Thr
 145 150 155 160
 His Ser Pro Pro Arg Ala Thr Thr Arg Thr Ala Arg Arg Thr Thr Thr
 165 170 175
 Leu Arg Thr Ser Ser Thr Arg Lys Arg Pro Ser Thr Ala Ser Val Gln
 180 185 190
 Pro Asp Ile Ser Ala Thr Thr His Lys Asn Glu Glu Ala Ser Pro Ala
 195 200 205
 Ser Pro Gln Thr Ser Ala Ser Thr Thr Arg Ile Gln Arg Lys Ser Val
 210 215 220
 Glu Ala Asn Thr Ser Thr Thr Tyr Asn Gln Thr Ser
 225 230 235

<210> 422
 <211> 120
 <212> PRT
 <213> Homo sapiens

<400> 422
 Gln Val Thr Leu Arg Glu Ser Gly Pro Ala Leu Val Lys Pro Thr Gln
 1 5 10 15
 Thr Leu Thr Leu Thr Cys Thr Phe Ser Gly Phe Ser Leu Ser Thr Ala
 20 25 30
 Gly Met Ser Val Gly Trp Ile Arg Gln Pro Pro Gly Lys Ala Leu Glu
 35 40 45
 Trp Leu Ala Asp Ile Trp Trp Asp Asp Lys Lys His Tyr Asn Pro Ser
 50 55 60
 Leu Lys Asp Arg Leu Thr Ile Ser Lys Asp Thr Ser Lys Asn Gln Val
 65 70 75 80
 Val Leu Lys Val Thr Asn Met Asp Pro Ala Asp Thr Ala Thr Tyr Tyr
 85 90 95
 Cys Ala Arg Asp Met Ile Phe Asn Phe Tyr Phe Asp Val Trp Gly Gln
 100 105 110

Gly Thr Thr Val Thr Val Ser Ser
115 120

<210> 423
<211> 106
<212> PRT
<213> Homo sapiens

<400> 423
Asp Ile Gln Met Thr Gln Ser Pro Ser Thr Leu Ser Ala Ser Val Gly
1 5 10 15
Asp Arg Val Thr Ile Thr Cys Ser Ala Ser Ser Arg Val Gly Tyr Met
20 25 30
His Trp Tyr Gln Gln Lys Pro Gly Lys Ala Pro Lys Leu Leu Ile Tyr
35 40 45
Asp Thr Leu Leu Leu Asp Ser Gly Val Pro Ser Arg Phe Ser Gly Ser
50 55 60
Gly Ser Gly Thr Glu Phe Thr Leu Thr Ile Ser Ser Leu Gln Pro Asp
65 70 75 80
Asp Phe Ala Thr Tyr Tyr Cys Phe Gln Gly Ser Gly Tyr Pro Phe Thr
85 90 95
Phe Gly Gly Gly Thr Lys Leu Glu Ile Lys
100 105

<210> 424
<211> 532
<212> PRT
<213> Avian pneumovirus

<220>
<223> Avian pneumovirus fusion protein gene

<400> 424
Met Ser Trp Lys Val Val Leu Leu Leu Val Leu Leu Ala Thr Pro Thr
1 5 10 15
Gly Gly Leu Glu Glu Ser Tyr Leu Glu Glu Ser Cys Ser Thr Val Thr
20 25 30
Arg Gly Tyr Leu Ser Val Leu Arg Thr Gly Trp Tyr Thr Asn Val Phe
35 40 45
Thr Leu Gly Val Gly Asp Val Lys Asn Leu Thr Cys Thr Asp Gly Pro
50 55 60
Ser Leu Ile Arg Thr Glu Leu Glu Leu Thr Lys Asn Ala Leu Glu Glu
65 70 75 80
Leu Lys Thr Val Ser Ala Asp Gln Leu Ala Lys Glu Ala Arg Ile Met
85 90 95
Ser Pro Arg Lys Ala Arg Phe Val Leu Gly Ala Ile Ala Leu Gly Val
100 105 110
Ala Thr Ala Ala Val Thr Ala Gly Val Ala Ile Ala Lys Thr Ile
115 120 125
Arg Leu Glu Gly Glu Val Ala Ala Ile Lys Gly Ala Leu Arg Lys Thr
130 135 140
Asn Glu Ala Val Ser Thr Leu Gly Asn Gly Val Arg Val Leu Ala Thr
145 150 155 160
Ala Val Asn Asp Leu Lys Asp Phe Ile Ser Lys Lys Leu Thr Pro Ala
165 170 175
Ile Asn Arg Asn Lys Cys Asp Ile Ser Asp Leu Lys Met Ala Val Ser
180 185 190
Phe Gly Gln Tyr Asn Arg Arg Phe Leu Asn Val Val Arg Gln Phe Ser
195 200 205

```

Asp Asn Ala Gly Ile Thr Pro Ala Ile Ser Leu Asp Leu Met Thr Asp
 210                215                220
Ala Glu Leu Val Arg Ala Val Ser Asn Met Pro Thr Ser Ser Gly Gln
 225                230                235                240
Ile Asn Leu Met Leu Glu Asn Arg Ala Met Val Arg Arg Lys Gly Phe
                245                250                255
Gly Ile Leu Ile Gly Val Tyr Gly Ser Ser Val Val Tyr Ile Val Gln
 260                265                270
Leu Pro Ile Phe Gly Val Ile Asp Thr Pro Cys Trp Arg Val Lys Ala
 275                280                285
Ala Pro Leu Cys Ser Gly Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg
 290                295                300
Glu Asp Gln Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr
 305                310                315                320
Pro Asn Glu Glu Asp Cys Glu Val Arg Ser Asp His Val Phe Cys Asp
                325                330                335
Thr Ala Ala Gly Ile Asn Val Ala Lys Glu Ser Glu Glu Cys Asn Arg
 340                345                350
Asn Ile Ser Thr Thr Lys Tyr Pro Cys Lys Val Ser Thr Gly Arg His
 355                360                365
Pro Ile Ser Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys
 370                375                380
Tyr Asp Gly Met Ser Cys Ser Ile Gly Ser Asn Lys Val Gly Ile Ile
 385                390                395                400
Arg Pro Leu Gly Lys Gly Cys Ser Tyr Ile Ser Asn Gln Asp Ala Asp
                405                410                415
Thr Val Thr Ile Asp Asn Thr Val Tyr Gln Leu Ser Lys Val Glu Gly
 420                425                430
Glu Gln His Thr Ile Lys Gly Lys Pro Val Ser Ser Asn Phe Asp Pro
 435                440                445
Ile Glu Phe Pro Glu Asp Gln Phe Asn Val Ala Leu Asp Gln Val Phe
 450                455                460
Glu Ser Val Glu Lys Ser Gln Asn Leu Ile Asp Gln Ser Asn Lys Ile
 465                470                475                480
Leu Asp Ser Ile Glu Lys Gly Asn Ala Gly Phe Val Ile Val Ile Val
                485                490                495
Leu Ile Val Leu Leu Met Leu Ala Ala Val Gly Val Gly Val Phe Phe
 500                505                510
Val Val Lys Lys Arg Lys Ala Ala Pro Lys Phe Pro Met Glu Met Asn
 515                520                525
Gly Val Asn Asn
 530

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<210> 425
<211> 537
<212> PRT
<213> Avian pneumovirus

```

```

<220>
<223> Avian pneumovirus isolate 1b fusion protein mRNA

```

```

<400> 425
Met Ser Trp Lys Val Val Leu Leu Leu Val Leu Leu Ala Thr Pro Thr
 1                5                10                15
Gly Gly Leu Glu Glu Ser Tyr Leu Glu Glu Ser Cys Ser Thr Val Thr
 20                25                30
Arg Gly Tyr Leu Ser Val Leu Arg Thr Gly Trp Tyr Thr Asn Val Phe
 35                40                45
Thr Leu Glu Val Gly Asp Val Glu Asn Leu Thr Cys Thr Asp Gly Pro
 50                55                60

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Ser	Leu	Ile	Arg	Thr	Glu	Leu	Glu	Leu	Thr	Lys	Asn	Ala	Leu	Glu	Glu	65	70	75	80
Leu	Lys	Thr	Val	Ser	Ala	Asp	Gln	Leu	Ala	Lys	Glu	Ala	Arg	Ile	Met	85	90	95	
Ser	Pro	Arg	Lys	Ala	Arg	Phe	Val	Leu	Gly	Ala	Ile	Ala	Leu	Gly	Val	100	105	110	
Ala	Thr	Ala	Ala	Ala	Val	Thr	Ala	Gly	Val	Ala	Ile	Ala	Lys	Thr	Ile	115	120	125	
Arg	Leu	Glu	Gly	Glu	Val	Ala	Ala	Ile	Lys	Gly	Ala	Leu	Arg	Lys	Thr	130	135	140	
Asn	Glu	Ala	Val	Ser	Thr	Leu	Gly	Asn	Gly	Val	Arg	Val	Leu	Ala	Thr	145	150	155	160
Ala	Val	Asn	Asp	Leu	Lys	Asp	Phe	Ile	Ser	Lys	Lys	Leu	Thr	Pro	Ala	165	170	175	
Ile	Asn	Arg	Asn	Lys	Cys	Asp	Ile	Ser	Asp	Leu	Lys	Met	Ala	Val	Ser	180	185	190	
Phe	Gly	Gln	Tyr	Asn	Arg	Arg	Phe	Leu	Asn	Val	Val	Arg	Gln	Phe	Ser	195	200	205	
Asp	Asn	Ala	Gly	Ile	Thr	Pro	Ala	Ile	Ser	Leu	Asp	Leu	Met	Thr	Asp	210	215	220	
Ala	Glu	Leu	Val	Arg	Ala	Val	Ser	Asn	Met	Pro	Thr	Ser	Ser	Gly	Gln	225	230	235	240
Ile	Asn	Leu	Met	Leu	Glu	Asn	Arg	Ala	Met	Val	Arg	Arg	Lys	Gly	Phe	245	250	255	
Gly	Ile	Leu	Ile	Gly	Val	Tyr	Gly	Ser	Ser	Val	Val	Tyr	Ile	Val	Gln	260	265	270	
Leu	Pro	Ile	Phe	Gly	Val	Ile	Asp	Thr	Pro	Cys	Trp	Lys	Val	Lys	Ala	275	280	285	
Ala	Pro	Leu	Cys	Ser	Gly	Lys	Asp	Gly	Asn	Tyr	Ala	Cys	Leu	Leu	Arg	290	295	300	
Glu	Asp	Gln	Gly	Trp	Tyr	Cys	Gln	Asn	Ala	Gly	Ser	Thr	Val	Tyr	Tyr	305	310	315	320
Pro	Asn	Glu	Glu	Asp	Cys	Glu	Val	Arg	Ser	Asp	His	Val	Phe	Cys	Asp	325	330	335	
Thr	Ala	Ala	Gly	Ile	Asn	Val	Ala	Lys	Glu	Ser	Glu	Glu	Cys	Asn	Arg	340	345	350	
Asn	Ile	Ser	Thr	Thr	Lys	Tyr	Pro	Cys	Lys	Val	Ser	Thr	Gly	Arg	His	355	360	365	
Pro	Ile	Ser	Met	Val	Ala	Leu	Ser	Pro	Leu	Gly	Ala	Leu	Val	Ala	Cys	370	375	380	
Tyr	Asp	Gly	Met	Ser	Cys	Ser	Ile	Gly	Ser	Asn	Lys	Val	Gly	Ile	Ile	385	390	395	400
Arg	Pro	Leu	Gly	Lys	Gly	Cys	Ser	Tyr	Ile	Ser	Asn	Gln	Asp	Ala	Asp	405	410	415	
Thr	Val	Thr	Ile	Asp	Asn	Thr	Val	Tyr	Gln	Leu	Ser	Lys	Val	Glu	Gly	420	425	430	
Glu	Gln	His	Thr	Ile	Lys	Gly	Lys	Pro	Val	Ser	Ser	Asn	Phe	Asp	Pro	435	440	445	
Ile	Glu	Phe	Pro	Glu	Asp	Gln	Phe	Asn	Val	Ala	Leu	Asp	Gln	Val	Phe	450	455	460	
Glu	Ser	Val	Glu	Lys	Ser	Gln	Asn	Leu	Ile	Asp	Gln	Ser	Asn	Lys	Ile	465	470	475	480
Leu	Asp	Ser	Ile	Glu	Lys	Gly	Asn	Ala	Gly	Phe	Val	Ile	Val	Ile	Val	485	490	495	
Leu	Ile	Val	Leu	Leu	Met	Leu	Ala	Ala	Val	Gly	Val	Gly	Val	Phe	Phe	500	505	510	
Val	Val	Lys	Lys	Arg	Lys	Ala	Ala	Pro	Lys	Phe	Pro	Met	Glu	Met	Asn	515	520	525	
Gly	Val	Asn	Asn	Lys	Gly	Phe	Ile	Pro								530	535		

<210> 426
 <211> 538
 <212> PRT
 <213> Turkey rhinotracheitis virus

<220>

<223> Turkey rhinotracheitis virus gene for fusion
 protein (F1 and F2 subunits), complete cds

<400> 426

```

Met Asp Val Arg Ile Cys Leu Leu Leu Phe Leu Ile Ser Asn Pro Ser
 1           5           10           15
Ser Cys Ile Gln Glu Thr Tyr Asn Glu Glu Ser Cys Ser Thr Val Thr
           20           25           30
Arg Gly Tyr Lys Ser Val Leu Arg Thr Gly Trp Tyr Thr Asn Val Phe
           35           40           45
Asn Leu Glu Ile Gly Asn Val Glu Asn Ile Thr Cys Asn Asp Gly Pro
           50           55           60
Ser Leu Ile Asp Thr Glu Leu Val Leu Thr Lys Asn Ala Leu Arg Glu
           65           70           75           80
Leu Lys Thr Val Ser Ala Asp Gln Val Ala Lys Glu Ser Arg Leu Ser
           85           90           95
Ser Pro Arg Arg Arg Arg Phe Val Leu Gly Ala Ile Ala Leu Gly Val
           100          105          110
Ala Thr Ala Ala Ala Val Thr Ala Gly Val Ala Leu Ala Lys Thr Ile
           115          120          125
Arg Leu Glu Gly Glu Val Lys Ala Ile Lys Asn Ala Leu Arg Asn Thr
           130          135          140
Asn Glu Ala Val Ser Thr Leu Gly Asn Gly Val Arg Val Leu Ala Thr
           145          150          155          160
Ala Val Asn Asp Leu Lys Glu Phe Ile Ser Lys Lys Leu Thr Pro Ala
           165          170          175
Ile Asn Gln Asn Lys Cys Asn Ile Ala Asp Ile Lys Met Ala Ile Ser
           180          185          190
Phe Gly Gln Asn Asn Arg Arg Phe Leu Asn Val Val Arg Gln Phe Ser
           195          200          205
Asp Ser Ala Gly Ile Thr Ser Ala Val Ser Leu Asp Leu Met Thr Asp
           210          215          220
Asp Glu Leu Val Arg Ala Ile Asn Arg Met Pro Thr Ser Ser Gly Gln
           225          230          235          240
Ile Ser Leu Met Leu Asn Asn Arg Ala Met Val Arg Arg Lys Gly Phe
           245          250          255
Gly Ile Leu Ile Gly Val Tyr Asp Gly Thr Val Val Tyr Met Val Gln
           260          265          270
Leu Pro Ile Phe Gly Val Ile Glu Thr Pro Cys Trp Arg Val Val Ala
           275          280          285
Ala Pro Leu Cys Arg Lys Glu Lys Gly Asn Tyr Ala Cys Ile Leu Arg
           290          295          300
Glu Asp Gln Gly Trp Tyr Cys Thr Asn Ala Gly Ser Thr Ala Tyr Tyr
           305          310          315          320
Pro Asn Lys Asp Asp Cys Glu Val Arg Asp Asp Tyr Val Phe Cys Asp
           325          330          335
Thr Ala Ala Gly Ile Asn Val Ala Leu Glu Val Glu Gln Cys Asn Tyr
           340          345          350
Asn Ile Ser Thr Ser Lys Tyr Pro Cys Lys Val Ser Thr Gly Arg His
           355          360          365
Pro Val Ser Met Val Ala Leu Thr Pro Leu Gly Gly Leu Val Ser Cys
           370          375          380
Tyr Glu Ser Val Ser Cys Ser Ile Gly Ser Asn Lys Val Gly Ile Ile
           385          390          395          400
Lys Gln Leu Gly Lys Gly Cys Thr His Ile Pro Asn Asn Glu Ala Asp

```

```

                405                410                415
Thr Ile Thr Ile Asp Asn Thr Val Tyr Gln Leu Ser Lys Val Val Gly
                420                425                430
Glu Gln Arg Thr Ile Lys Gly Ala Pro Val Val Asn Asn Phe Asn Pro
                435                440                445
Ile Leu Phe Pro Glu Asp Gln Phe Asn Val Ala Leu Asp Gln Val Phe
                450                455                460
Glu Ser Ile Asp Arg Ser Gln Asp Leu Ile Asp Lys Ser Asn Asp Leu
465                470                475                480
Leu Gly Ala Asp Ala Lys Ser Lys Ala Gly Ile Ala Ile Ala Ile Val
                485                490                495
Val Leu Val Ile Leu Gly Ile Phe Phe Leu Leu Ala Val Ile Tyr Tyr
                500                505                510
Cys Ser Arg Val Arg Lys Thr Lys Pro Lys His Asp Tyr Pro Ala Thr
                515                520                525
Thr Gly His Ser Ser Met Ala Tyr Val Ser
                530                535

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```

<210> 427
<211> 537
<212> PRT
<213> Avian penumovirus

```

```

<220>
<223> Avian pneumovirus fusion glycoprotein (F) gene,
        complete cds

```

```

<400> 427
Met Ser Trp Lys Val Val Leu Leu Leu Val Leu Leu Ala Thr Pro Thr
 1                5                10                15
Gly Gly Leu Glu Glu Ser Tyr Leu Glu Glu Ser Cys Ser Thr Val Thr
                20                25                30
Arg Gly Tyr Leu Ser Val Leu Arg Thr Gly Trp Tyr Thr Asn Val Phe
 35                40                45
Thr Leu Glu Val Gly Asp Val Glu Asn Leu Thr Cys Thr Asp Gly Pro
 50                55                60
Ser Leu Ile Arg Thr Glu Leu Glu Leu Thr Lys Asn Ala Leu Glu Glu
65                70                75                80
Leu Lys Thr Val Ser Ala Asp Gln Leu Ala Lys Glu Ala Arg Ile Met
                85                90                95
Ser Pro Arg Lys Ala Arg Phe Val Leu Gly Ala Ile Ala Leu Gly Val
                100                105                110
Ala Thr Ala Ala Ala Val Thr Ala Gly Val Ala Ile Ala Lys Thr Ile
                115                120                125
Arg Leu Glu Gly Glu Val Ala Ala Ile Lys Gly Ala Leu Arg Lys Thr
130                135                140
Asn Glu Ala Val Ser Thr Leu Gly Asn Gly Val Arg Val Leu Ala Thr
145                150                155                160
Ala Val Asn Asp Leu Lys Asp Phe Ile Ser Lys Lys Leu Thr Pro Ala
                165                170                175
Ile Asn Arg Asn Lys Cys Asp Ile Ser Asp Leu Lys Met Ala Val Ser
                180                185                190
Phe Gly Gln Tyr Asn Arg Arg Phe Leu Asn Val Val Arg Gln Phe Ser
                195                200                205
Asp Asn Ala Gly Ile Thr Pro Ala Ile Ser Leu Asp Leu Met Thr Asp
210                215                220
Ala Glu Leu Val Arg Ala Val Ser Asn Met Pro Thr Ser Ser Gly Gln
225                230                235                240
Ile Asn Leu Met Leu Glu Asn Arg Ala Met Val Arg Arg Lys Gly Phe
                245                250                255

```

Gly Ile Leu Ile Gly Val Tyr Gly Ser Ser Val Val Tyr Ile Val Gln
 260 265 270
 Leu Pro Ile Phe Gly Val Ile Asp Thr Pro Cys Trp Lys Val Lys Ala
 275 280 285
 Ala Pro Leu Cys Ser Gly Lys Asp Gly Asn Tyr Ala Cys Leu Leu Arg
 290 295 300
 Glu Asp Gln Gly Trp Tyr Cys Gln Asn Ala Gly Ser Thr Val Tyr Tyr
 305 310 315 320
 Pro Asn Glu Glu Asp Cys Glu Val Arg Ser Asp His Val Phe Cys Asp
 325 330 335
 Thr Ala Ala Gly Ile Asn Val Ala Lys Glu Ser Glu Glu Cys Asn Arg
 340 345 350
 Asn Ile Ser Thr Thr Lys Tyr Pro Cys Lys Val Ser Thr Gly Arg His
 355 360 365
 Pro Ile Ser Met Val Ala Leu Ser Pro Leu Gly Ala Leu Val Ala Cys
 370 375 380
 Tyr Asp Gly Met Ser Cys Ser Ile Gly Ser Asn Lys Val Gly Ile Ile
 385 390 395 400
 Arg Pro Leu Gly Lys Gly Cys Ser Tyr Ile Ser Asn Gln Asp Ala Asp
 405 410 415
 Thr Val Thr Ile Asp Asn Thr Val Tyr Gln Leu Ser Lys Val Glu Gly
 420 425 430
 Glu Gln His Thr Ile Lys Gly Lys Pro Val Ser Ser Asn Phe Asp Pro
 435 440 445
 Ile Glu Phe Pro Glu Asp Gln Phe Asn Ile Ala Leu Asp Gln Val Phe
 450 455 460
 Glu Ser Val Glu Lys Ser Gln Asn Leu Ile Asp Gln Ser Asn Lys Ile
 465 470 475 480
 Leu Asp Ser Ile Glu Lys Gly Asn Ala Gly Phe Val Ile Val Ile Val
 485 490 495
 Leu Ile Val Leu Leu Met Leu Ala Ala Val Gly Val Gly Val Phe Phe
 500 505 510
 Val Val Lys Lys Arg Lys Ala Ala Pro Lys Phe Pro Met Glu Met Asn
 515 520 525
 Gly Val Asn Asn Lys Gly Phe Ile Pro
 530 535

<210> 428

<211> 391

<212> PRT

<213> Turkey rhinotracheitis virus

<220>

 <223> Turkey rhinotracheitis virus (strain CVL14/1)
 attachment protien (G) mRNA, complete cds

<400> 428

Met Gly Ser Lys Leu Tyr Met Ala Gln Gly Thr Ser Ala Tyr Gln Thr
 1 5 10 15
 Ala Val Gly Phe Trp Leu Asp Ile Gly Arg Arg Tyr Ile Leu Ala Ile
 20 25 30
 Val Leu Ser Ala Phe Gly Leu Thr Cys Thr Val Thr Ile Ala Leu Thr
 35 40 45
 Val Ser Val Ile Val Glu Gln Ser Val Leu Glu Glu Cys Arg Asn Tyr
 50 55 60
 Asn Gly Gly Asp Arg Asp Trp Trp Ser Thr Thr Gln Glu Gln Pro Thr
 65 70 75 80
 Thr Ala Pro Ser Ala Thr Pro Ala Gly Asn Tyr Gly Gly Leu Gln Thr
 85 90 95
 Ala Arg Thr Arg Lys Ser Glu Ser Cys Leu His Val Gln Ile Ser Tyr


```

      100      105      110
Gly Asp Met Tyr Ser Arg Ser Asp Thr Val Leu Gly Gly Phe Asp Cys
      115      120      125
Met Gly Leu Leu Val Leu Cys Lys Ser Gly Pro Ile Cys Gln Arg Asp
      130      135      140
Asn Gln Val Asp Pro Thr Ala Leu Cys His Cys Arg Val Asp Leu Ser
145      150      155      160
Ser Val Asp Cys Cys Lys Val Asn Lys Ile Ser Thr Asn Ser Ser Thr
      165      170      175
Thr Ser Glu Pro Gln Lys Thr Asn Pro Ala Trp Pro Ser Gln Asp Asn
      180      185      190
Thr Asp Ser Asp Pro Asn Pro Gln Gly Ile Thr Thr Ser Thr Ala Thr
      195      200      205
Leu Leu Ser Thr Ser Leu Gly Leu Met Leu Thr Ser Lys Thr Gly Thr
      210      215      220
His Lys Ser Gly Pro Pro Gln Ala Leu Pro Gly Ser Asn Thr Asn Gly
225      230      235      240
Lys Thr Thr Thr Asp Arg Glu Pro Gly Pro Thr Asn Gln Pro Asn Ser
      245      250      255
Thr Thr Asn Gly Gln His Asn Lys His Thr Gln Arg Met Thr Pro Pro
      260      265      270
Pro Ser His Asp Asn Thr Arg Thr Ile Leu Gln His Thr Thr Pro Trp
      275      280      285
Glu Lys Thr Phe Ser Thr Tyr Lys Pro Thr His Ser Pro Thr Asn Glu
      290      295      300
Ser Asp Gln Ser Leu Pro Thr Thr Gln Asn Ser Ile Asn Cys Glu His
305      310      315      320
Phe Asp Pro Gln Gly Lys Glu Lys Ile Cys Tyr Arg Val Gly Ser Tyr
      325      330      335
Asn Ser Asn Ile Thr Lys Gln Cys Arg Ile Asp Val Pro Leu Cys Ser
      340      345      350
Thr Tyr Ser Thr Val Cys Met Lys Thr Tyr Tyr Thr Glu Pro Phe Asn
      355      360      365
Cys Trp Arg Arg Ile Trp Arg Cys Leu Cys Asp Asp Gly Val Gly Leu
      370      375      380
Val Glu Trp Cys Cys Thr Ser
385      390

```

<210> 429
 <211> 414
 <212> PRT
 <213> rhinotracheitis virus

<220>
 <223> Turkey rhinotracheitis virus (strain 6574)
 attachment protein (G)

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<400> 429
Met Gly Ser Glu Leu Tyr Ile Ile Glu Gly Val Ser Ser Ser Glu Ile
 1      5      10      15
Val Leu Lys Gln Val Leu Arg Arg Ser Gln Lys Ile Leu Leu Gly Leu
      20      25      30
Val Leu Ser Ala Leu Gly Leu Thr Leu Thr Ser Thr Ile Val Ile Ser
      35      40      45
Ile Cys Ile Ser Val Glu Gln Val Lys Leu Arg Gln Cys Val Asp Thr
      50      55      60
Tyr Trp Ala Glu Asn Gly Ser Leu His Pro Gly Gln Ser Thr Glu Asn
      65      70      75      80
Thr Ser Thr Arg Gly Lys Thr Thr Thr Lys Asp Pro Arg Arg Leu Gln
      85      90      95
Ala Thr Gly Ala Gly Lys Phe Glu Ser Cys Gly Tyr Val Gln Val Val

```

```

      100      105      110
Asp Gly Asp Met His Asp Arg Ser Tyr Ala Val Leu Gly Gly Val Asp
      115      120      125
Cys Leu Gly Leu Leu Ala Leu Cys Glu Ser Gly Pro Ile Cys Gln Gly
      130      135      140
Asp Thr Trp Ser Glu Asp Gly Asn Phe Cys Arg Cys Thr Phe Ser Ser
145      150      155      160
His Gly Val Ser Cys Cys Lys Lys Pro Lys Ser Lys Ala Thr Thr Ala
      165      170      175
Gln Arg Asn Ser Lys Pro Ala Asn Ser Lys Ser Thr Pro Pro Val His
      180      185      190
Ser Asp Arg Ala Ser Lys Glu His Asn Pro Ser Gln Gly Glu Gln Pro
      195      200      205
Arg Arg Gly Pro Thr Ser Ser Lys Thr Thr Ile Ala Ser Thr Pro Ser
210      215      220
Thr Glu Asp Thr Ala Lys Pro Thr Ile Ser Lys Pro Lys Leu Thr Ile
225      230      235      240
Arg Pro Ser Gln Arg Gly Pro Ser Gly Ser Thr Lys Ala Ala Ser Ser
      245      250      255
Thr Pro Ser His Lys Thr Asn Thr Arg Gly Thr Ser Lys Thr Thr Asp
260      265      270
Gln Arg Pro Arg Thr Gly Pro Thr Pro Glu Arg Pro Arg Gln Thr His
275      280      285
Ser Thr Ala Thr Pro Pro Pro Thr Thr Pro Ile His Lys Gly Arg Ala
290      295      300
Pro Thr Pro Lys Pro Thr Thr Asp Leu Lys Val Asn Pro Arg Glu Gly
305      310      315      320
Ser Thr Ser Pro Thr Ala Ile Gln Lys Asn Pro Thr Thr Gln Ser Asn
      325      330      335
Leu Val Asp Cys Thr Leu Ser Asp Pro Asp Glu Pro Gln Arg Ile Cys
      340      345      350
Tyr Gln Val Gly Thr Tyr Asn Pro Ser Gln Ser Gly Thr Cys Asn Ile
355      360      365
Glu Val Pro Lys Cys Ser Thr Tyr Gly His Ala Cys Met Ala Thr Leu
370      375      380
Tyr Asp Thr Pro Phe Asn Cys Trp Arg Arg Thr Arg Arg Cys Ile Cys
385      390      395      400
Asp Ser Gly Gly Glu Leu Ile Glu Trp Cys Cys Thr Ser Gln
      405      410

```

<210> 430

<211> 46

<212> PRT

<213> human metapneumovirus

<220>

<223> Postulated HRA sequence of strain NL1/00

<400> 430

```

Lys Thr Ile Arg Leu Glu Ser Glu Val Thr Ala Ile Lys Asn Ala Leu
  1           5           10           15
Lys Lys Thr Asn Glu Ala Val Ser Thr Leu Gly Asn Gly Val Arg Val
      20      25      30
Leu Ala Thr Ala Val Arg Glu Leu Lys Asp Phe Val Ser Lys
      35      40      45

```

<210> 431

<211> 46

<212> PRT

<213> human metapneumovirus

<220>

<223> Postulated HRA sequence of strain NL17/00

<400> 431

```
Lys Thr Ile Arg Leu Glu Ser Glu Val Thr Ala Ile Lys Asn Ala Leu
 1           5           10           15
Lys Thr Thr Asn Glu Ala Val Ser Thr Leu Gly Asn Gly Val Arg Val
          20           25           30
Leu Ala Thr Ala Val Arg Glu Leu Lys Asp Phe Val Ser Lys
      35           40           45
```

<210> 432

<211> 46

<212> PRT

<213> human metapneumovirus

<220>

<223> Postulated HRA sequence of strain NL1/99

<400> 432

```
Lys Thr Ile Arg Leu Glu Ser Glu Val Asn Ala Ile Lys Gly Ala Leu
 1           5           10           15
Lys Gln Thr Asn Glu Ala Val Ser Thr Leu Gly Asn Gly Val Arg Val
          20           25           30
Leu Ala Thr Ala Val Arg Glu Leu Lys Glu Phe Val Ser Lys
      35           40           45
```

<210> 433

<211> 46

<212> PRT

<213> human metapneumovirus

<220>

<223> Postulated HRA sequence of strain NL1/94

<400> 433

```
Lys Thr Ile Arg Leu Glu Ser Glu Val Asn Ala Ile Lys Gly Ala Leu
 1           5           10           15
Lys Thr Thr Asn Glu Ala Val Ser Thr Leu Gly Asn Gly Val Arg Val
          20           25           30
Leu Ala Thr Ala Val Arg Glu Leu Lys Glu Phe Val Ser Lys
      35           40           45
```

<210> 434

<211> 29

<212> PRT

<213> human metapneumovirus

<220>

<223> Postulated HRB sequence of strain NL1/00

<400> 434

```
Asn Val Ala Leu Asp Gln Val Phe Glu Ser Ile Glu Asn Ser Gln Ala
 1           5           10           15
Leu Val Asp Gln Ser Asn Arg Ile Leu Ser Ser Ala Glu
          20           25
```

<210> 435

<211> 29

<212> PRT

<213> human metapneumovirus

<220>

<223> Postulated HRB sequence of strain NL17/00

<400> 435

Asn	Val	Ala	Leu	Asp	Gln	Val	Phe	Glu	Asn	Ile	Glu	Asn	Ser	Gln	Ala
1				5				10						15	
Leu	Val	Asp	Gln	Ser	Asn	Arg	Ile	Leu	Ser	Ser	Ala	Glu			
		20						25							

<210> 436

<211> 29

<212> PRT

<213> human metapneumovirus

<220>

<223> Postulated HRB sequence of strain NL1/99

<400> 436

Asn	Val	Ala	Leu	Asp	Gln	Val	Phe	Glu	Ser	Ile	Glu	Asn	Ser	Gln	Ala
1				5				10						15	
Leu	Val	Asp	Gln	Ser	Asn	Lys	Ile	Leu	Asn	Ser	Ala	Glu			
		20						25							

<210> 437

<211> 29

<212> PRT

<213> human metapneumovirus

<220>

<223> Postulated HRB sequence of strain NL1/94

<400> 437

Asn	Val	Ala	Leu	Asp	Gln	Val	Phe	Glu	Ser	Ile	Glu	Asn	Ser	Gln	Ala
1				5				10						15	
Leu	Val	Asp	Gln	Ser	Asn	Lys	Ile	Leu	Asn	Ser	Ala	Glu			
		20						25							

MICROORGANISMS

Optional Sheet in connection with the microorganism referred to on page 67-68 , lines 1-30; 1-18 of the description *

A. IDENTIFICATION OF DEPOSIT *

Further deposits are identified on an additional sheet *

Name of depositary institution *

American Type Culture Collection

Address of depositary institution (including postal code and country) *

10801 University Blvd.
Manassas, VA 20110-2209
USDate of deposit * January 19, 2001 Accession Number * I-2614**B. ADDITIONAL INDICATIONS *** (leave blank if not applicable). This information is continued on a separate attached sheet**C. DESIGNATED STATES FOR WHICH INDICATIONS ARE MADE *** (if the indications are not all designated States)**D. SEPARATE FURNISHING OF INDICATIONS *** (leave blank if not applicable)

The indications listed below will be submitted to the International Bureau later * (Specify the general nature of the indications e.g., "Accession Number of Deposit")

E. ☐ This sheet was received with the International application when filed (to be checked by the receiving Office)

 (Authorized Officer)
☒ The date of receipt (from the applicant) by the International Bureau *was **17 SEPTEMBER 2003****EKO**
(Authorized Officer)